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(54) SYSTEMS, METHODS, AND GRAPHICAL USER INTERFACES FOR INTERACTING WITH AUGMENTED AND VIRTUAL REALITY ENVIRONMENTS

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G06T 19/00	(2006.01)
G06F 3/0484	(2006.01)
G06F 3/0488	(2006.01)

(52) **U.S. Cl.**

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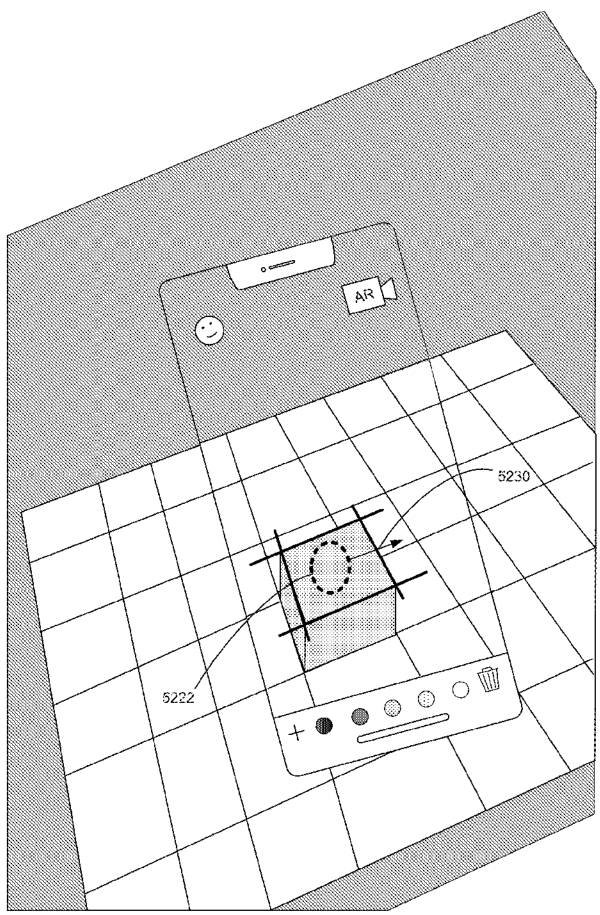
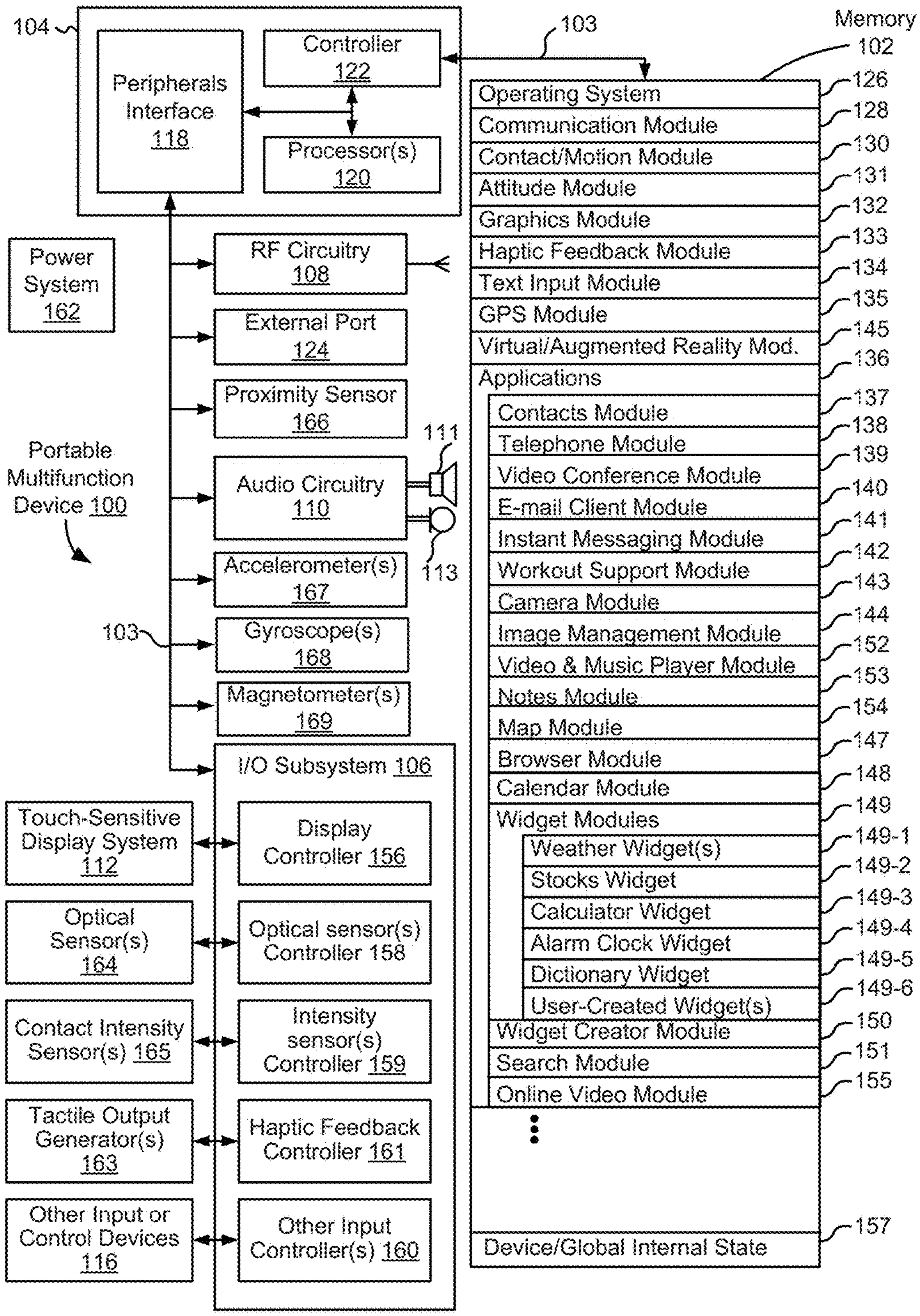
(57) **ABSTRACT**

A computer system concurrently displays, in an augmented reality environment, a representation of at least a portion of a field of view of one or more cameras that includes a respective physical object, which is updated as contents of the field of view change; and a respective virtual user interface object, at a respective location in the virtual user interface determined based on the location of the respective physical object in the field of view. While detecting an input at a location that corresponds to the displayed respective virtual user interface object, in response to detecting movement of the input relative to the respective physical object in the field of view of the one or more cameras, the system adjusts an appearance of the respective virtual user interface object in accordance with a magnitude of movement of the input relative to the respective physical object.





104
Peripherals Interface 118
Controller 122
Processor(s) 120
103
Memory 102
Operating System
126
Communication Module
128
Contact/Motion Module
130
Attitude Module
131
Graphics Module
132
Haptic Feedback Module
133
Text Input Module
134
GPS Module
135
Virtual/Augmented Reality Mod.
145
Applications
136
Contacts Module
137
Telephone Module
138
Video Conference Module
139
E-mail Client Module
140
Instant Messaging Module
141
Workout Support Module
142
Camera Module
143
Image Management Module
144
Video & Music Player Module
152
Notes Module
153
Map Module
154
Browser Module
147
Calendar Module
148
Widget Modules
149
Weather Widget(s)
149-1
Stocks Widget
149-2
Calculator Widget
149-3
Alarm Clock Widget
149-4
Dictionary Widget
149-5
User-Created Widget(s)
149-6
Widget Creator Module
150
Search Module
151
Online Video Module
155
Device/Global Internal State
157
Power System 162
RF Circuitry 108
External Port 124
Proximity Sensor 166
Audio Circuitry 110
111
113
Portable Multifunction Device 100
Accelerometer(s) 167
103
Gyroscope(s) 168
Magnetometer(s) 169
I/O Subsystem 106
Touch-Sensitive Display System 112
Display Controller 156
Optical Sensor(s) 164
Optical sensor(s) Controller 158
Contact Intensity Sensor(s) 165
Intensity sensor(s) Controller 159
Tactile Output Generator(s) 163
Haptic Feedback Controller 161
Other Input or Control Devices 116
Other Input Controller(s) 160

Figure 1A

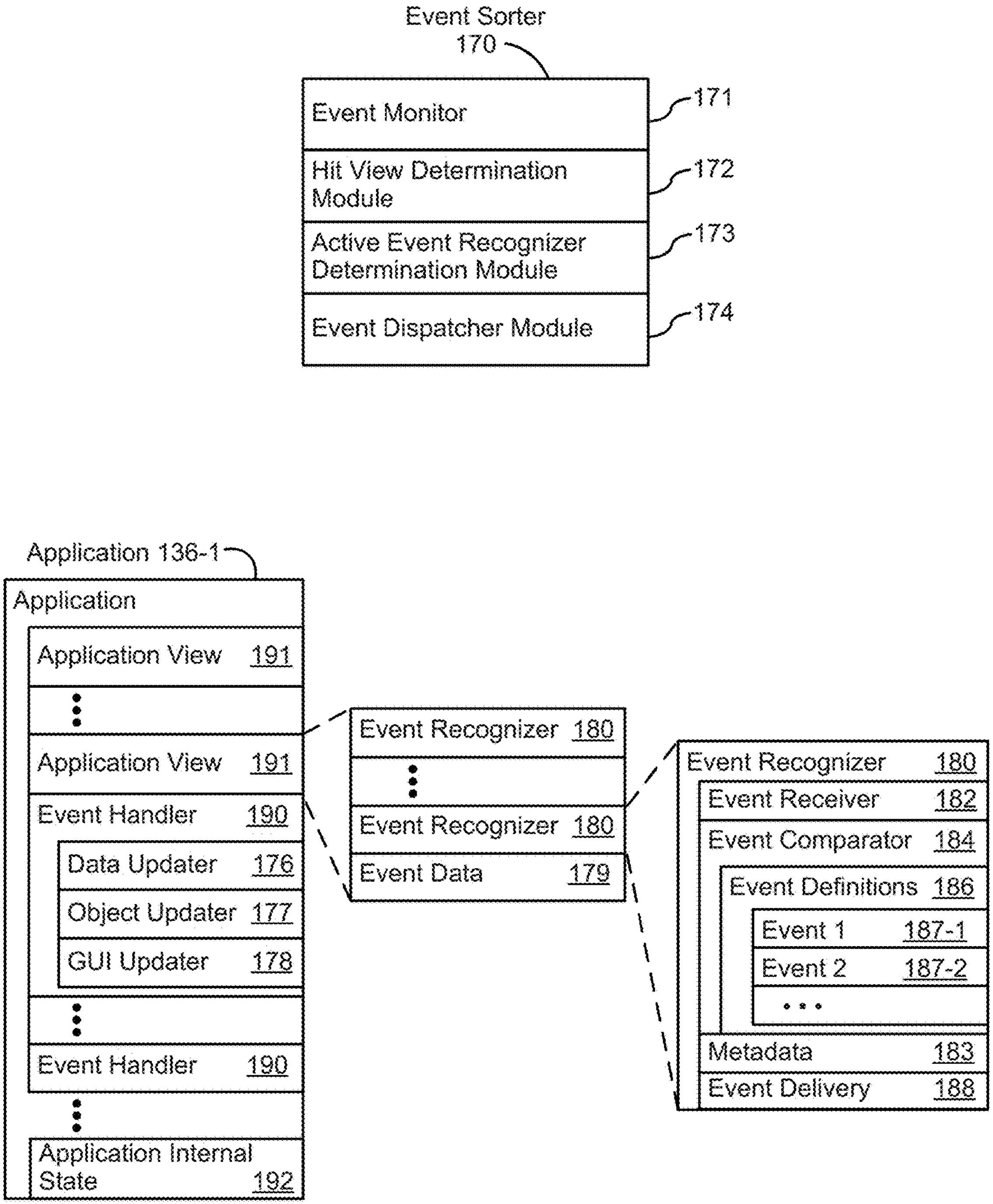
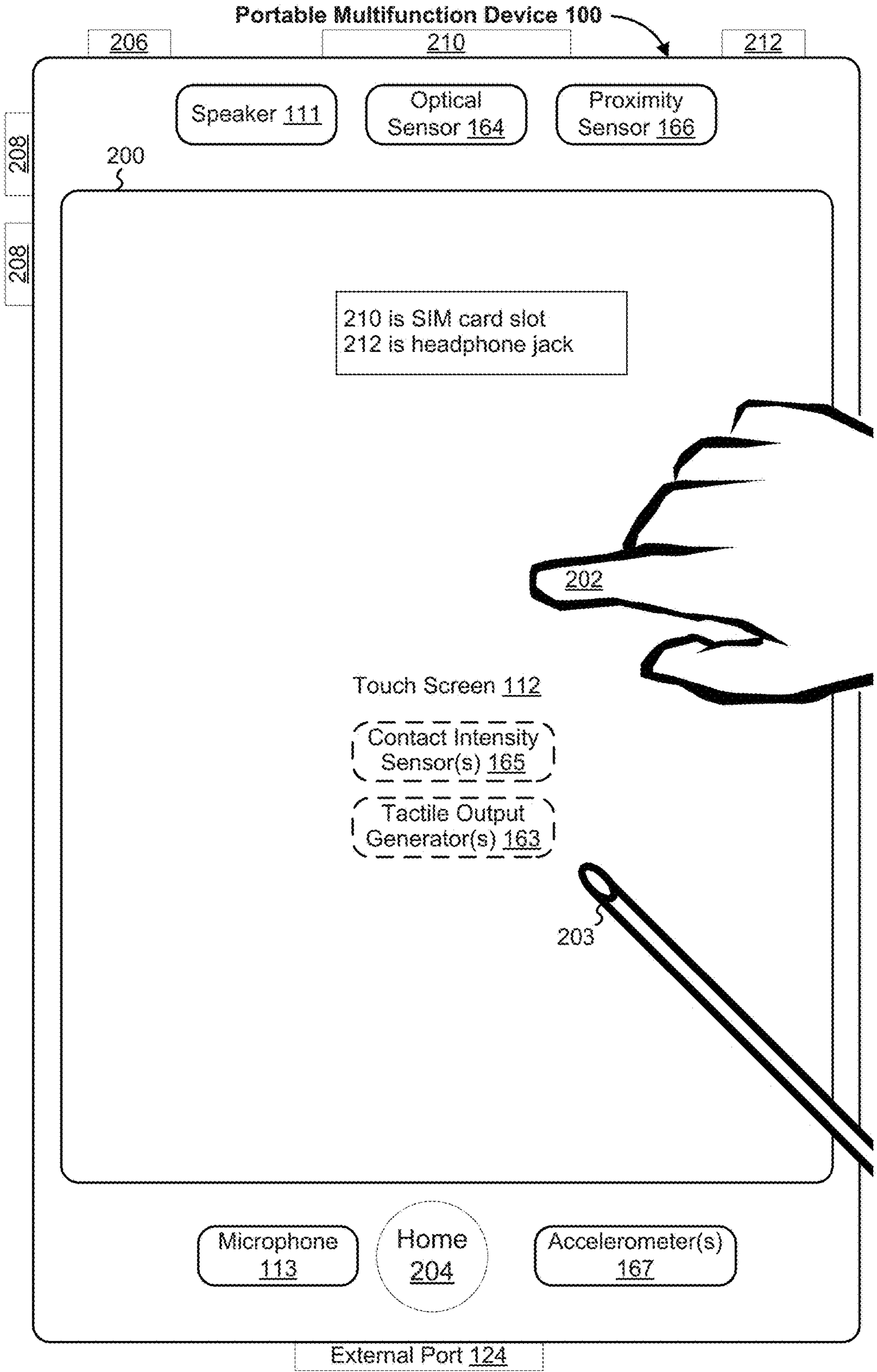
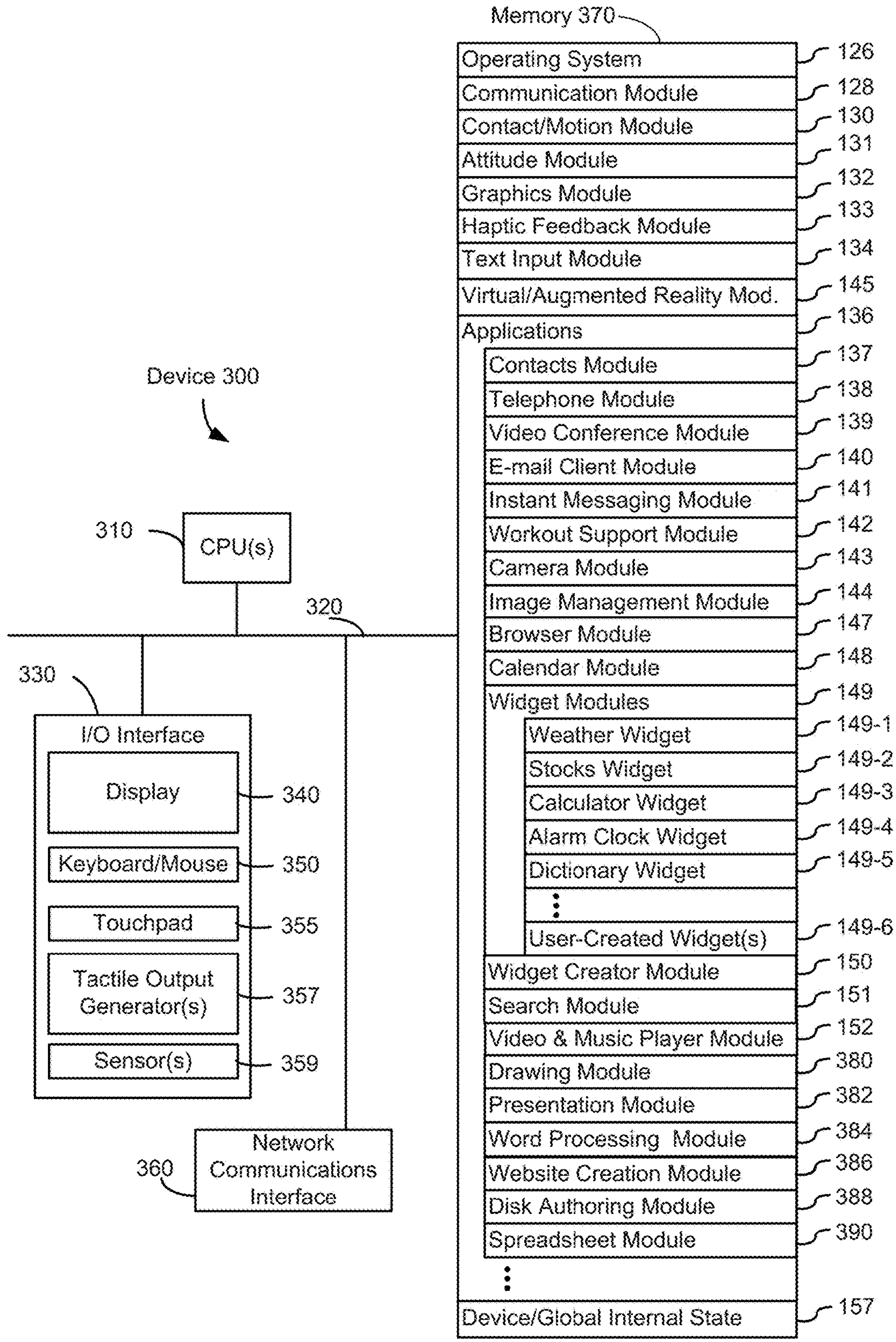

Event Sorter
170
Event Monitor
171
Hit View Determination Module
172
Active Event Recognizer Determination Module
173
Event Dispatcher Module
174
Application 136-1
Application
Application View 191
Application View 191
Event Handler 190
Data Updater 176
Object Updater 177
GUI Updater 178
Event Handler 190
Application Internal State 192
Event Recognizer 180
Event Recognizer 180
Event Data 179
Event Recognizer 180
Event Receiver 182
Event Comparator 184
Event Definitions 186
Event 1 187-1
Event 2 187-2
Metadata 183
Event Delivery 188

Figure 1B



Portable Multifunction Device 100
206
210
212
208
208
Speaker 111
Optical Sensor 164
Proximity Sensor 166
200
210 is SIM card slot
212 is headphone jack
202
Touch Screen 112
Contact Intensity Sensor(s) 165
Tactile Output Generator(s) 163
203
Microphone 113
Home 204
Accelerometer(s) 167
External Port 124

Figure 2



Memory 370
Operating System 126
Communication Module 128
Contact/Motion Module 130
Attitude Module 131
Graphics Module 132
Haptic Feedback Module 133
Text Input Module 134
Virtual/Augmented Reality Mod. 145
Applications 136
Contacts Module 137
Telephone Module 138
Video Conference Module 139
E-mail Client Module 140
Instant Messaging Module 141
Workout Support Module 142
Camera Module 143
Image Management Module 144
Browser Module 147
Calendar Module 148
Widget Modules 149
Weather Widget 149-1
Stocks Widget 149-2
Calculator Widget 149-3
Alarm Clock Widget 149-4
Dictionary Widget 149-5
User-Created Widget(s) 149-6
Widget Creator Module 150
Search Module 151
Video & Music Player Module 152
Drawing Module 380
Presentation Module 382
Word Processing Module 384
Website Creation Module 386
Disk Authoring Module 388
Spreadsheet Module 390
Device/Global Internal State 157
Device 300
310
CPU(s)
320
330
I/O Interface
Display 340
Keyboard/Mouse 350
Touchpad 355
Tactile Output Generator(s) 357
Sensor(s) 359
360
Network Communications Interface

Figure 3A

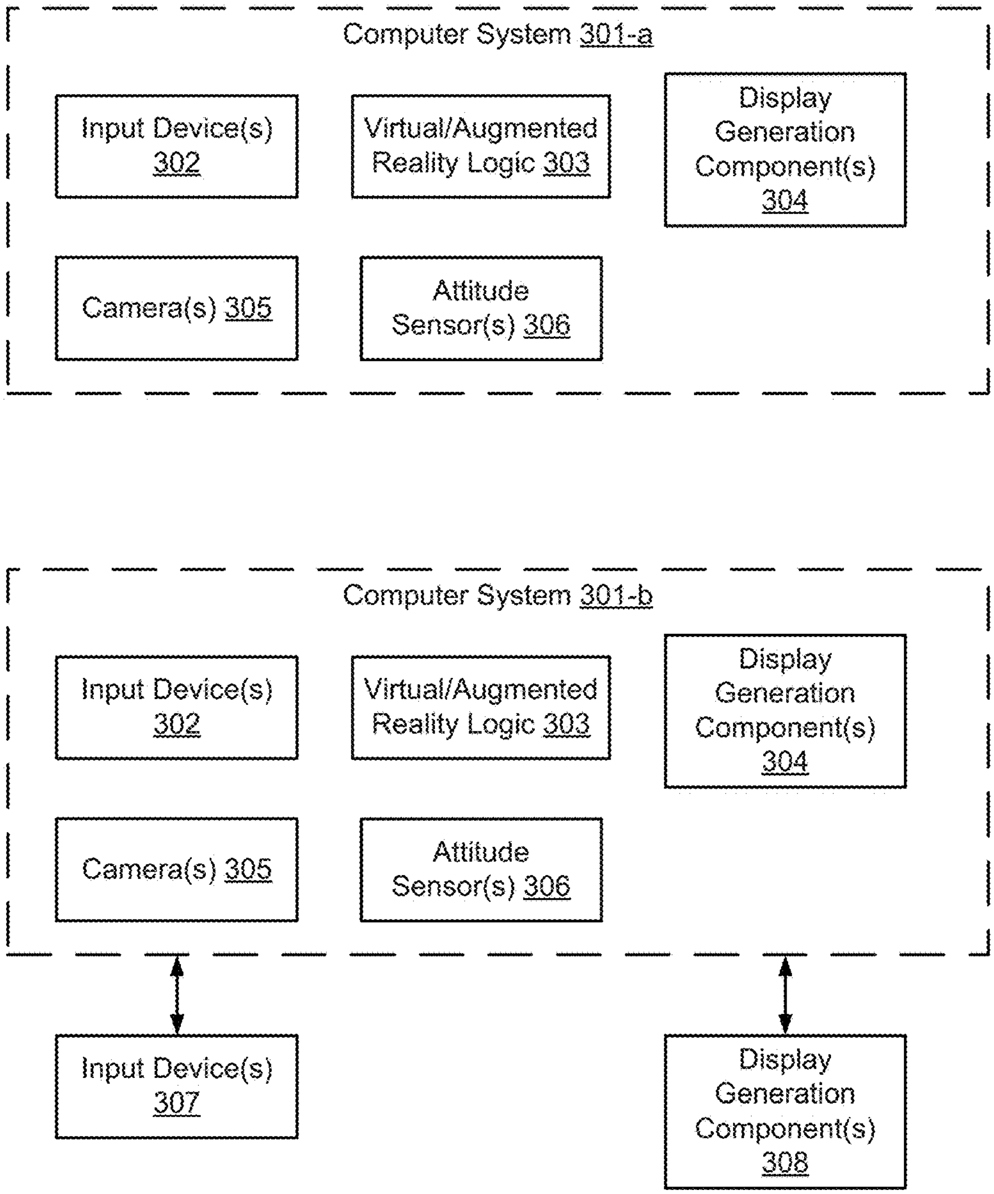

Computer System 301-a
Input Device(s) 302
Virtual/Augmented Reality Logic 303
Display Generation Component(s) 304
Camera(s) 305
Attitude Sensor(s) 306
Computer System 301-b
Input Device(s) 302
Virtual/Augmented Reality Logic 303
Display Generation Component(s) 304
Camera(s) 305
Attitude Sensor(s) 306
Input Device(s) 307
Display Generation Component(s) 308

Figure 3B

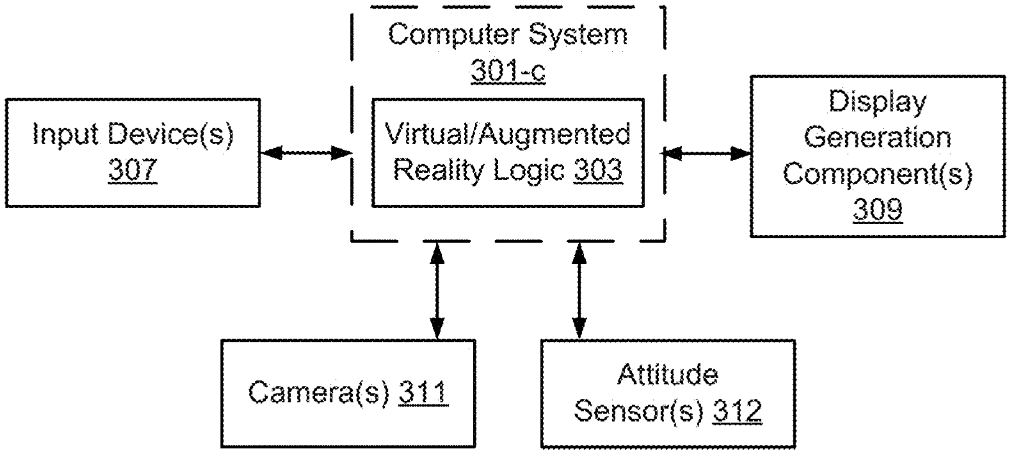

Computer System
301-c
Virtual/Augmented Reality Logic 303
Input Device(s) 307
Display Generation Component(s) 309
Camera(s) 311
Attitude Sensor(s) 312

Figure 3C

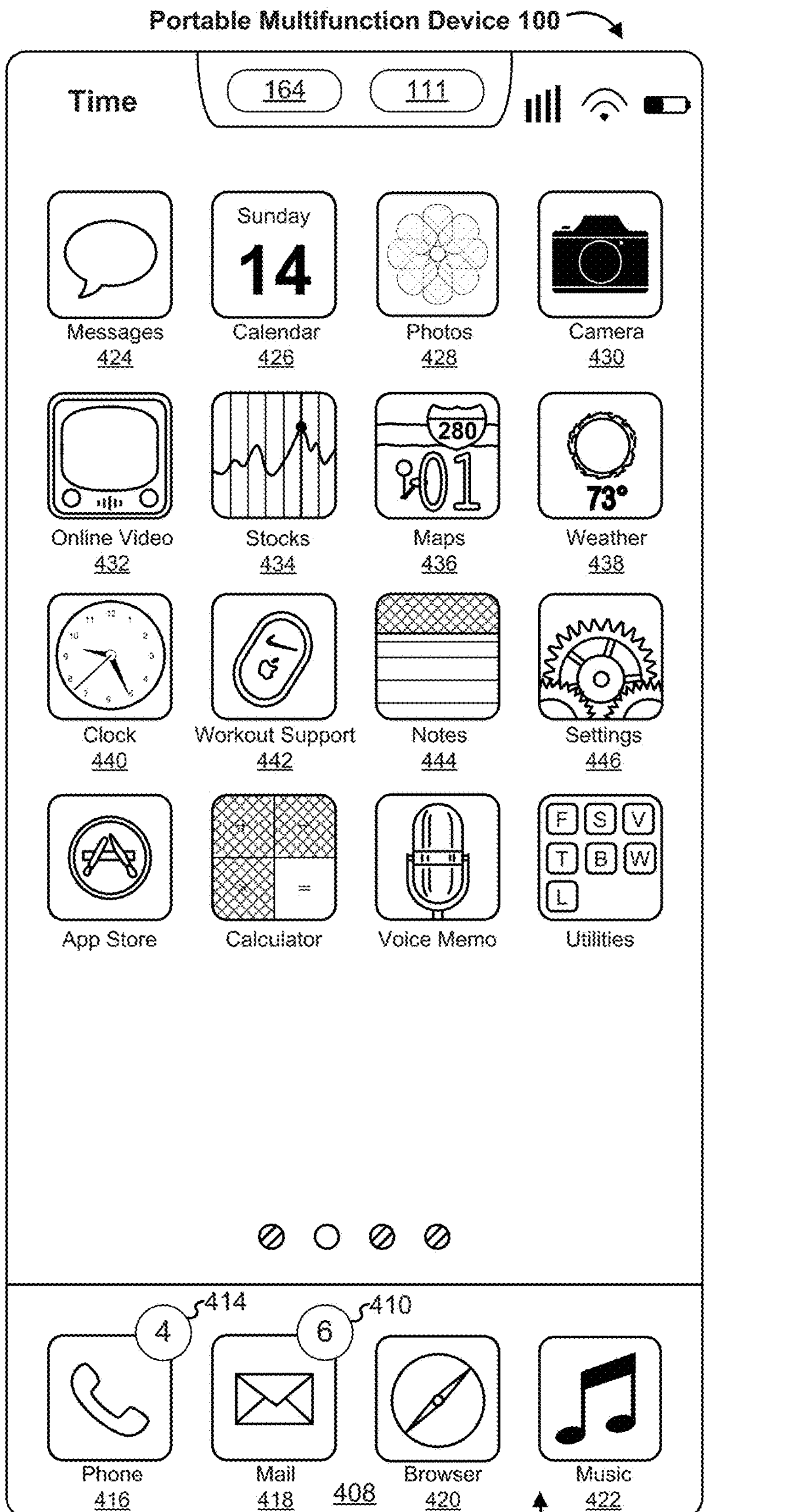
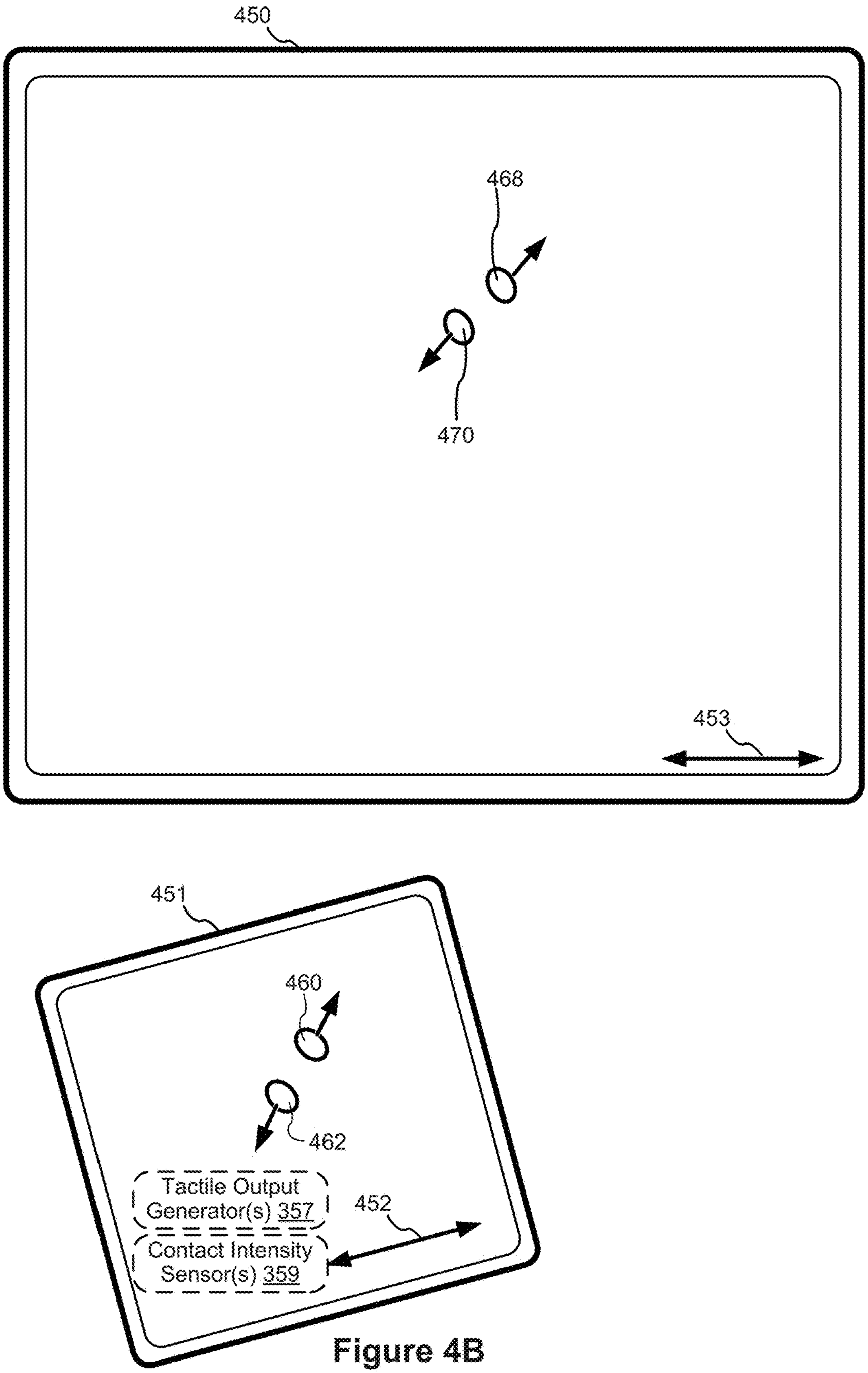

Portable Multifunction Device 100
Time
164
111
Sunday
14
Messages
424
Calendar
426
Photos
428
Camera
430
280
73°
Online Video
432
Stocks
434
Maps
436
Weather
438
Clock
440
Workout Support
442
Notes
444
Settings
446
F S V
T B W
L
App Store
Calculator
Voice Memo
Utilities
4
414
6
410
Phone
416
Mail
418
408
Browser
420
Music
422
Touch Screen 112

Figure 4A


450
468
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453
451
460
462
Tactile Output Generator(s) 357
452
Contact Intensity Sensor(s) 359

Figure 4B

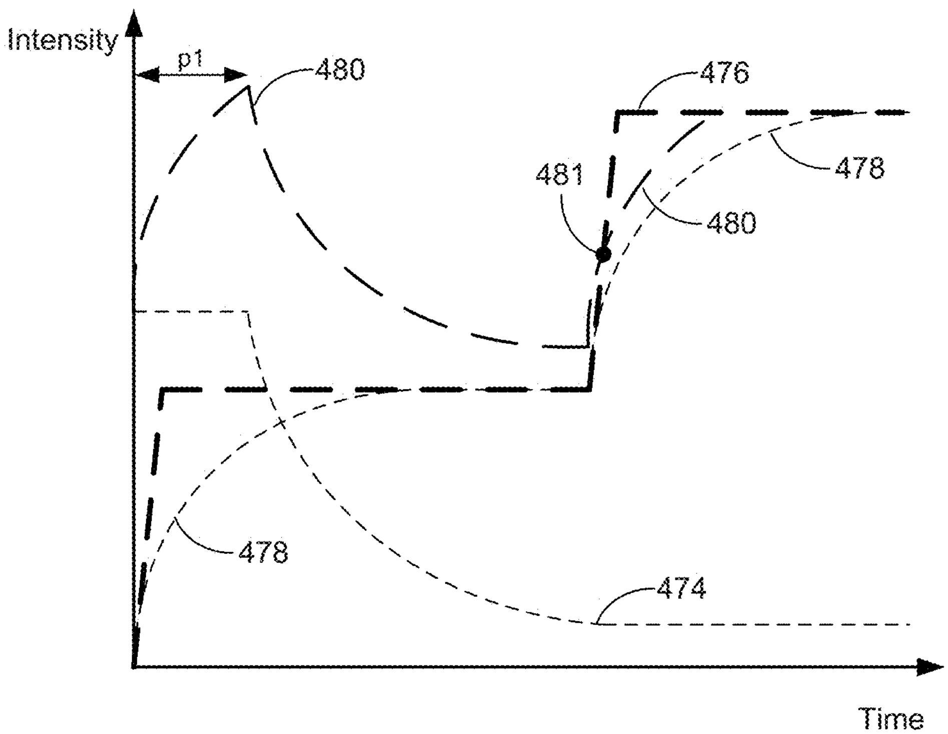


Figure 4C

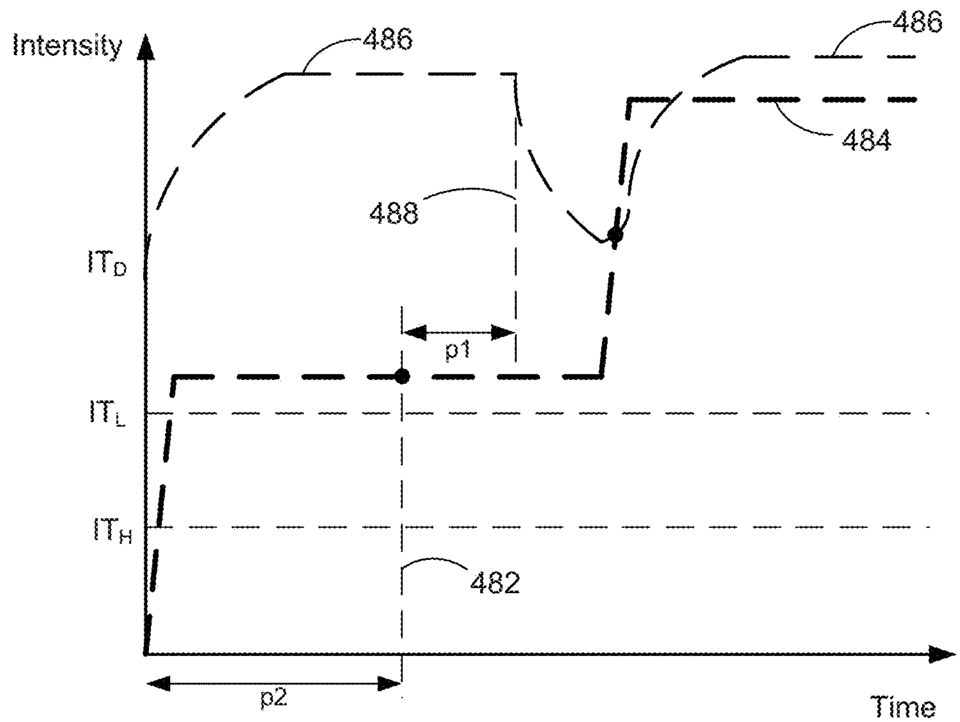


Figure 4D

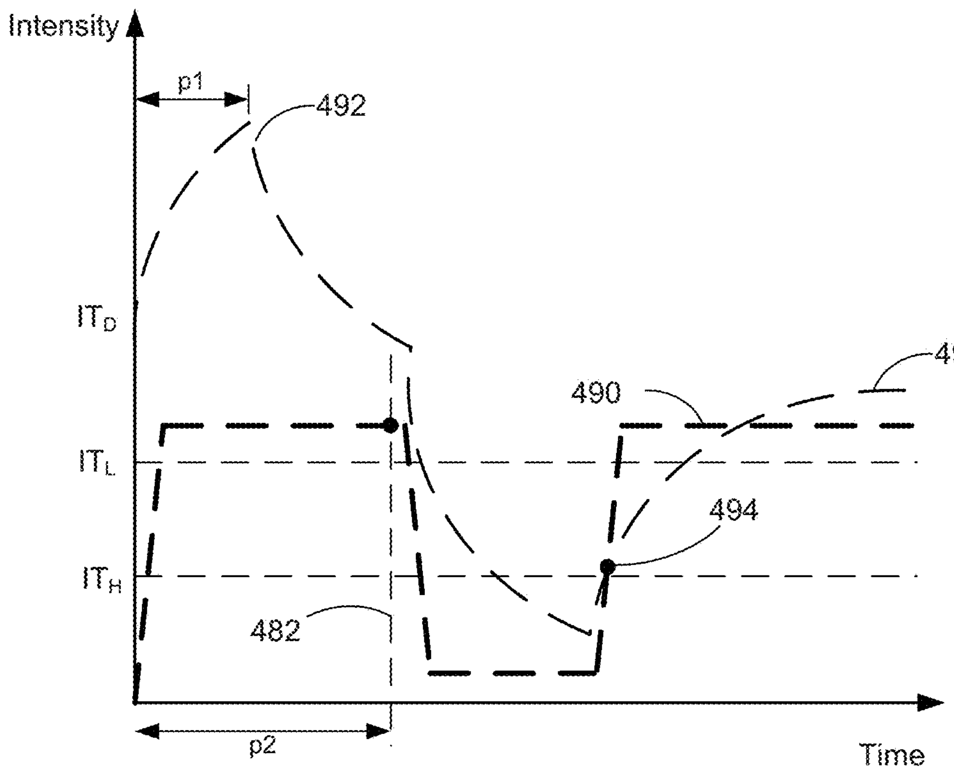
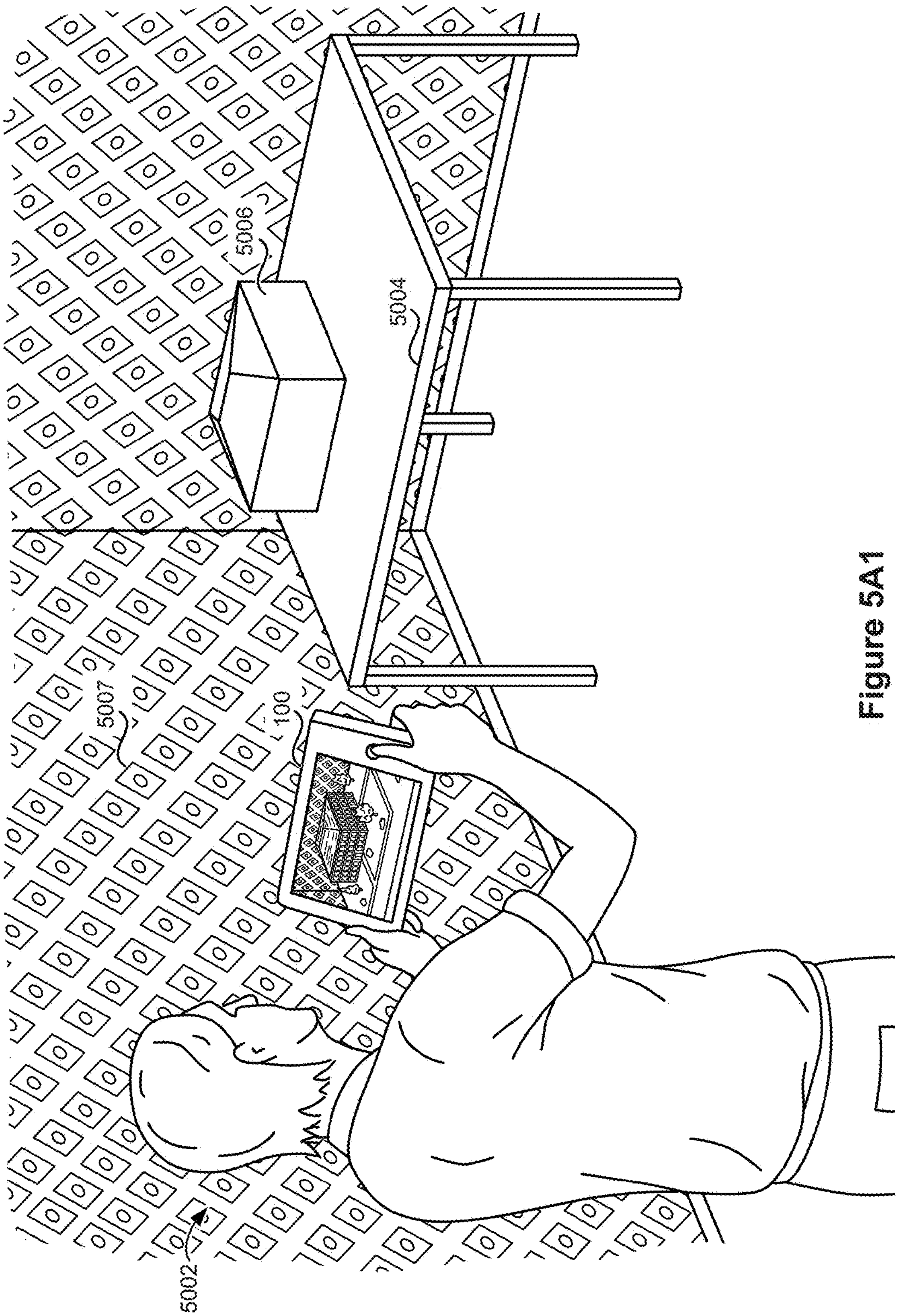


Figure 4E



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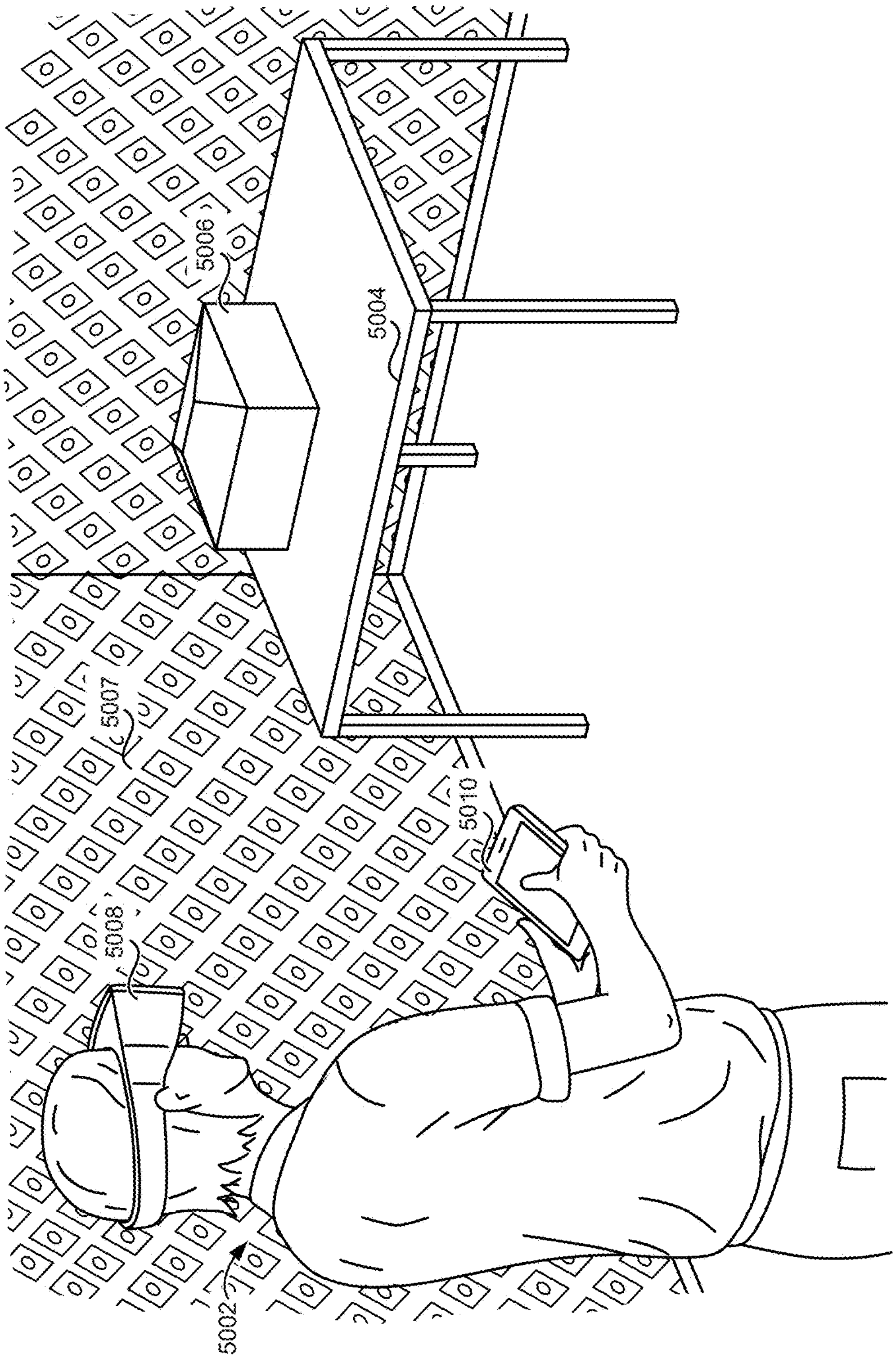
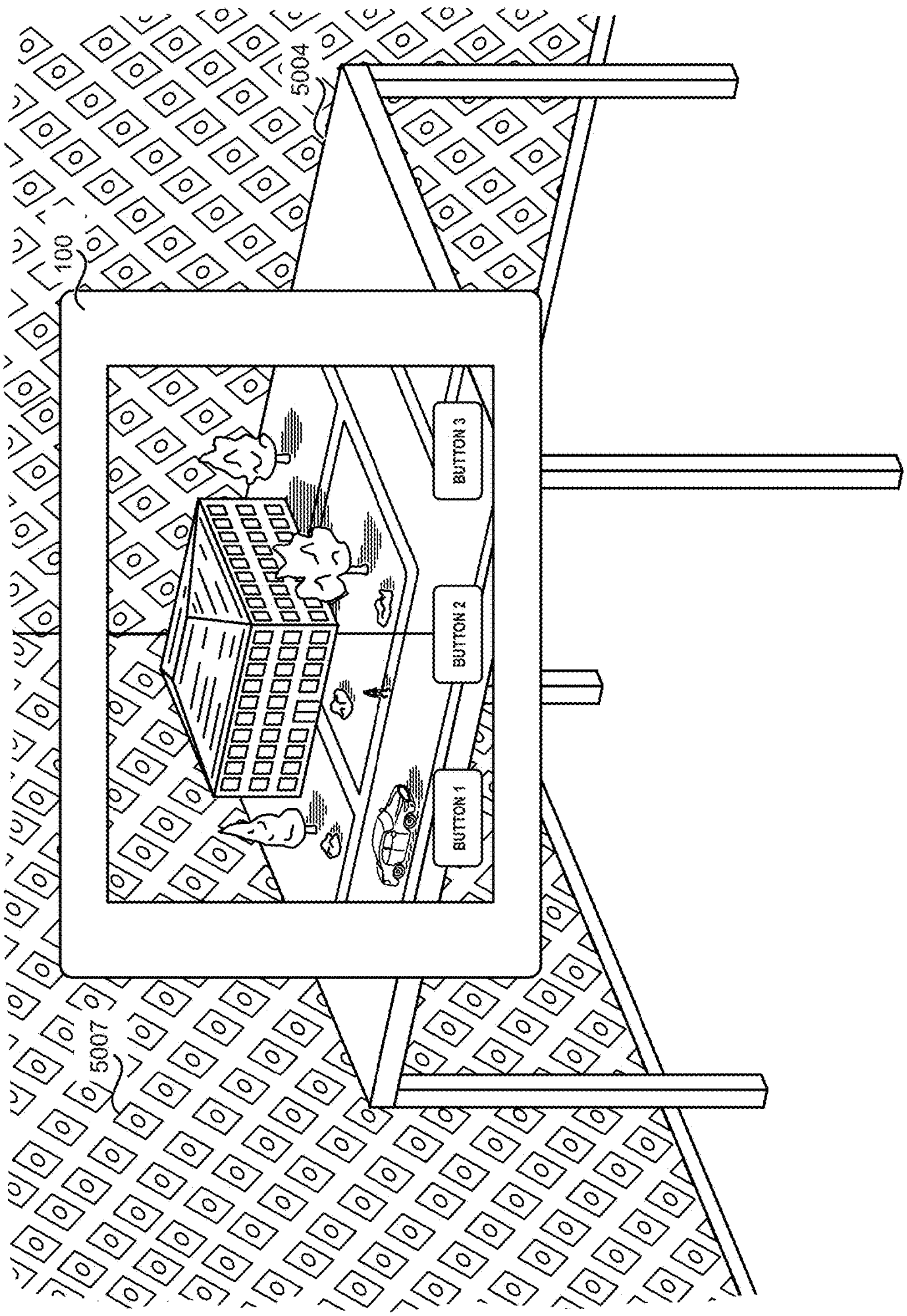


Figure 5A2



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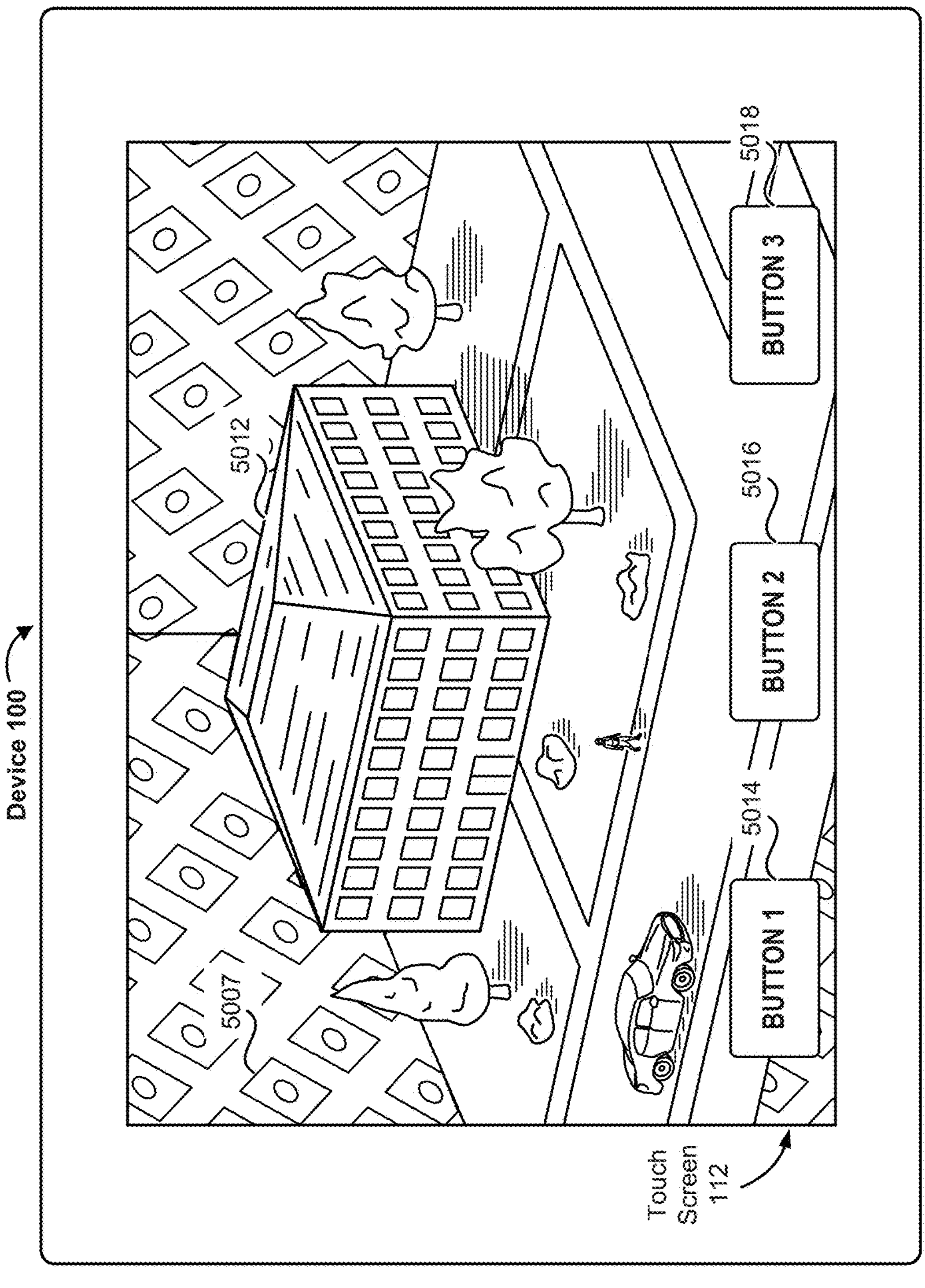
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5014
5016
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BUTTON 1
BUTTON 2
BUTTON 3
Touch Screen 112

Figure 5A4

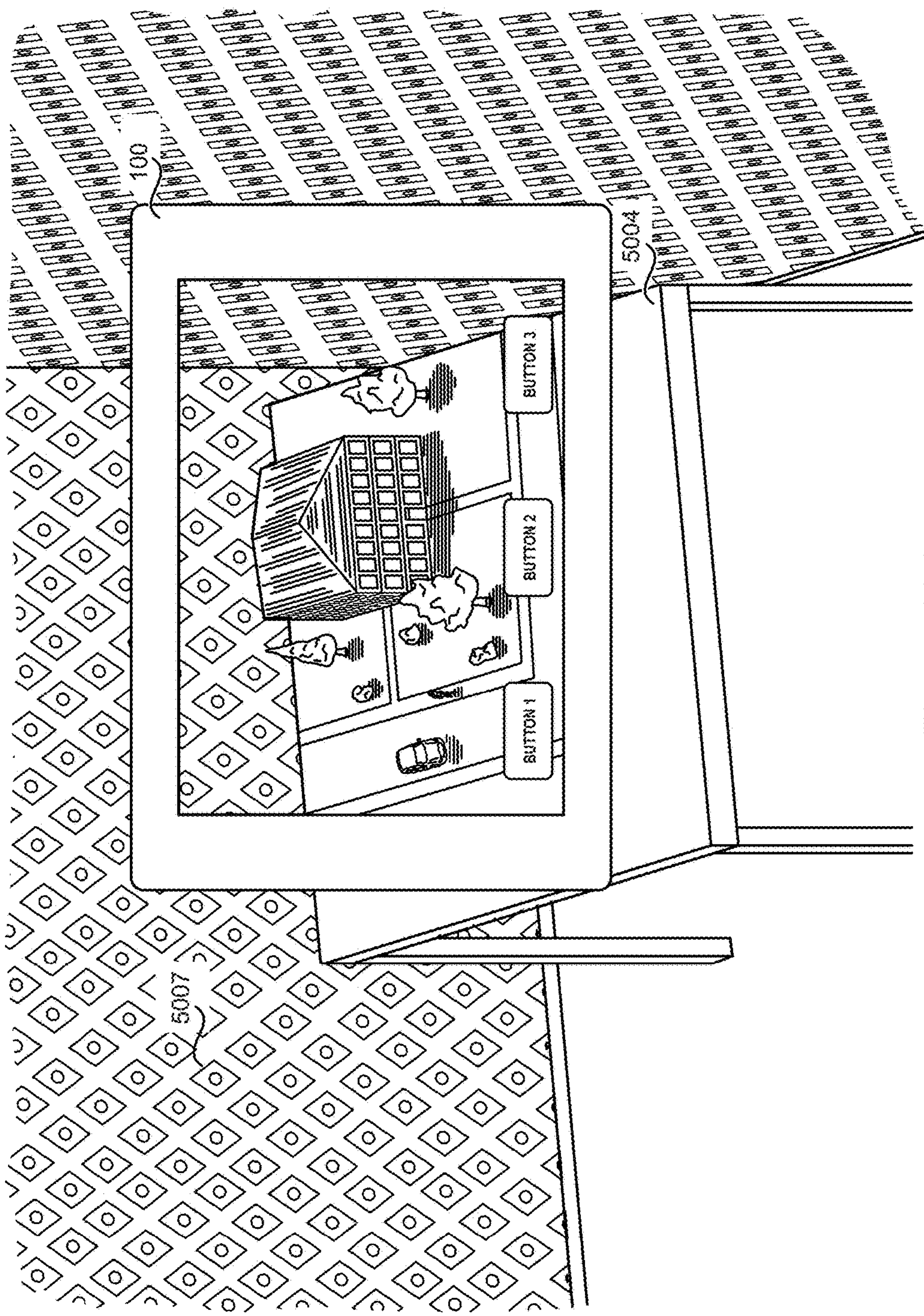
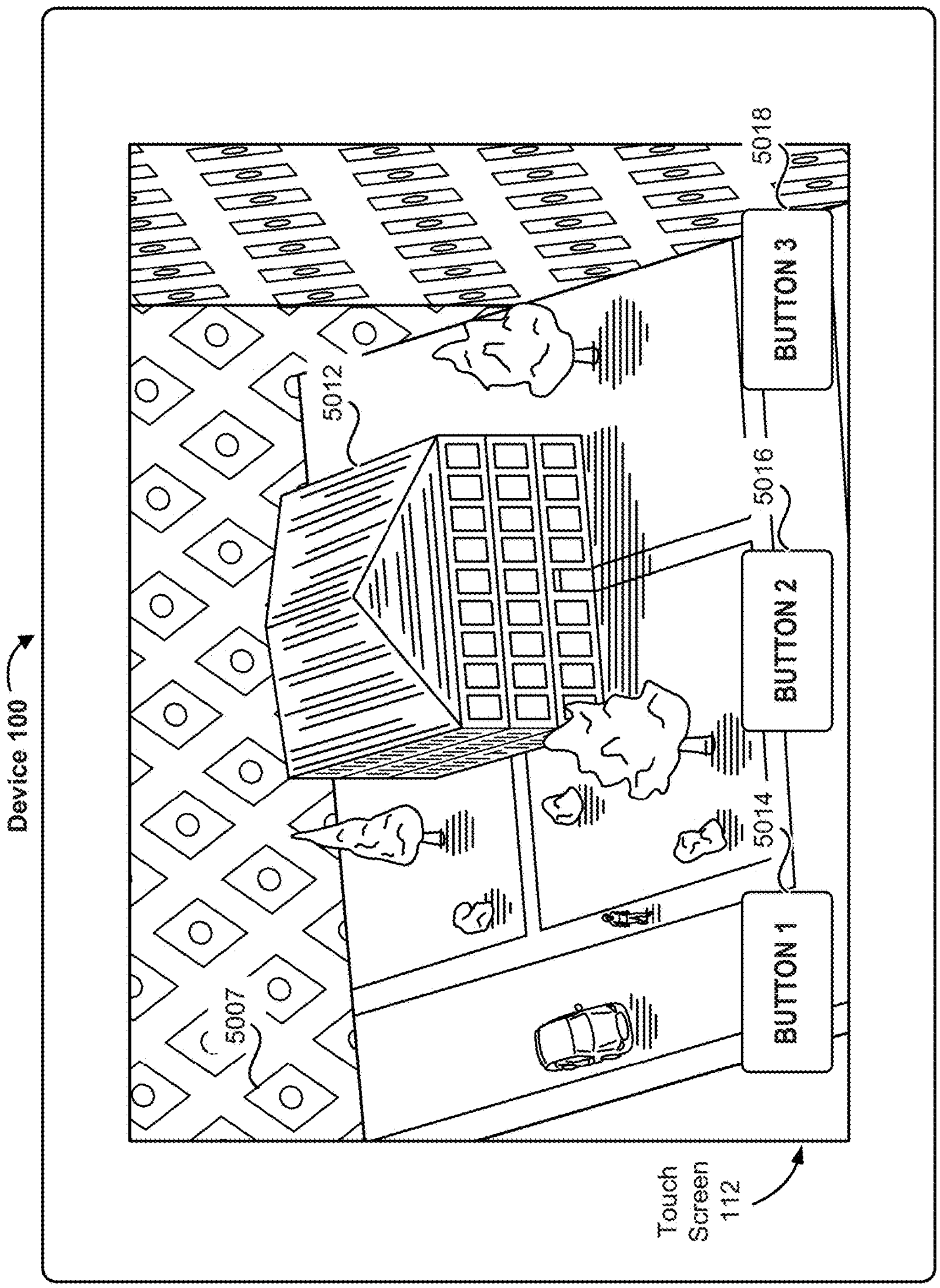


Figure 5A5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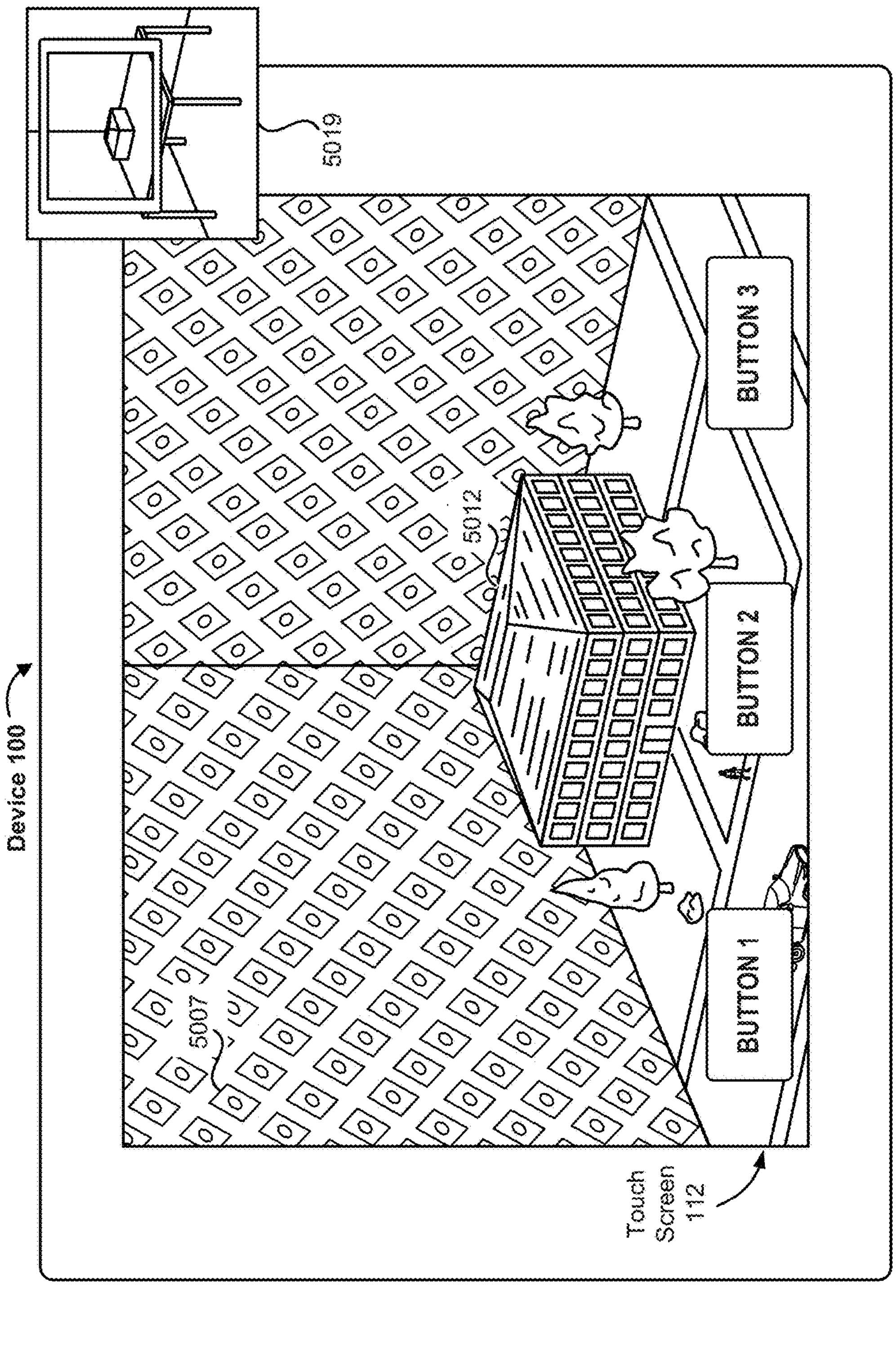
Touch Screen 112
5007
5012
5014
5016
5018
BUTTON 1
BUTTON 2
BUTTON 3

Figure 5A6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5019
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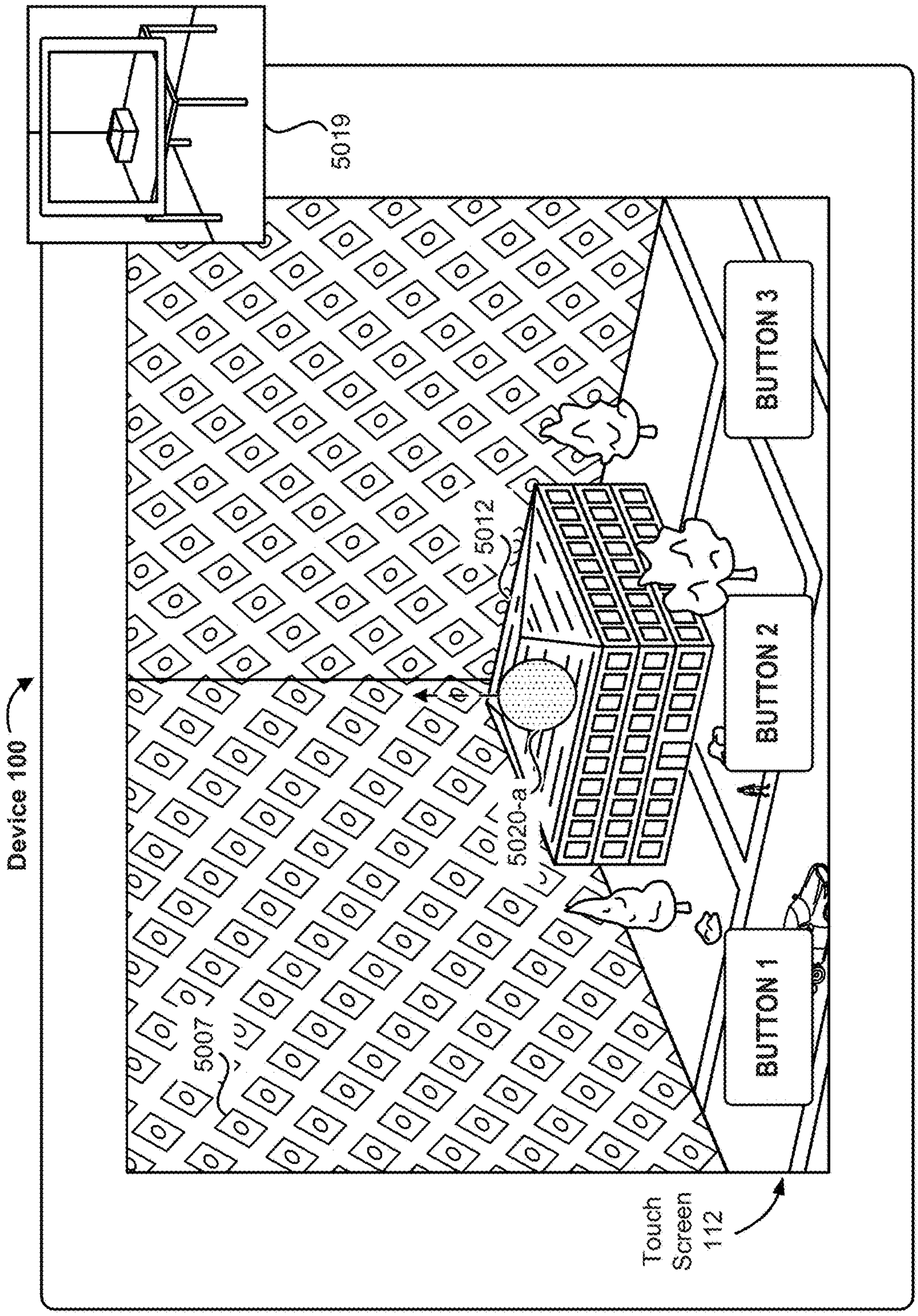
5007
BUTTON 1
BUTTON 2
BUTTON 3
Touch Screen 112

Figure 5A7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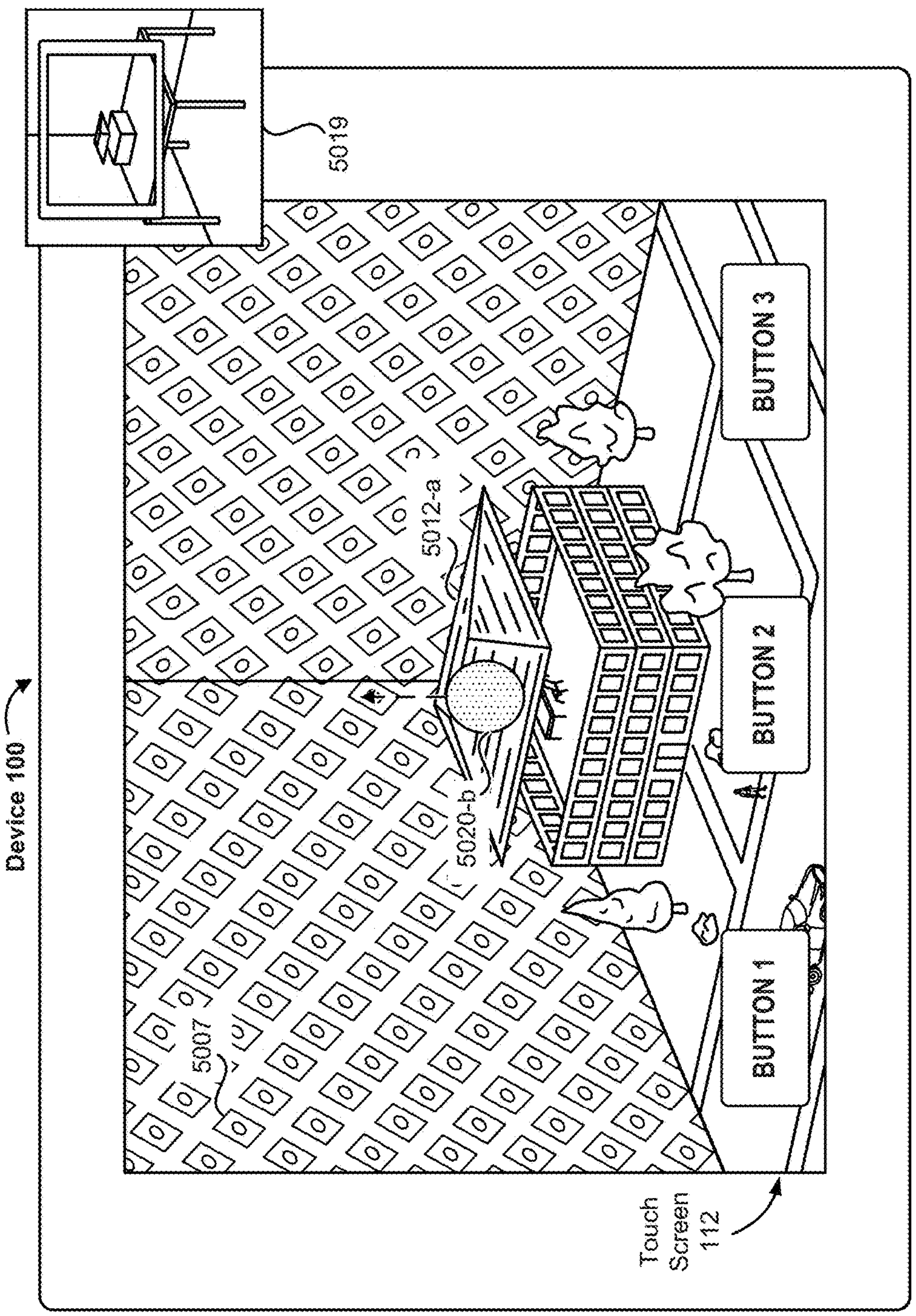
5012
5020-a
5007
BUTTON 1
BUTTON 2
BUTTON 3
Touch Screen 112

Figure 5A8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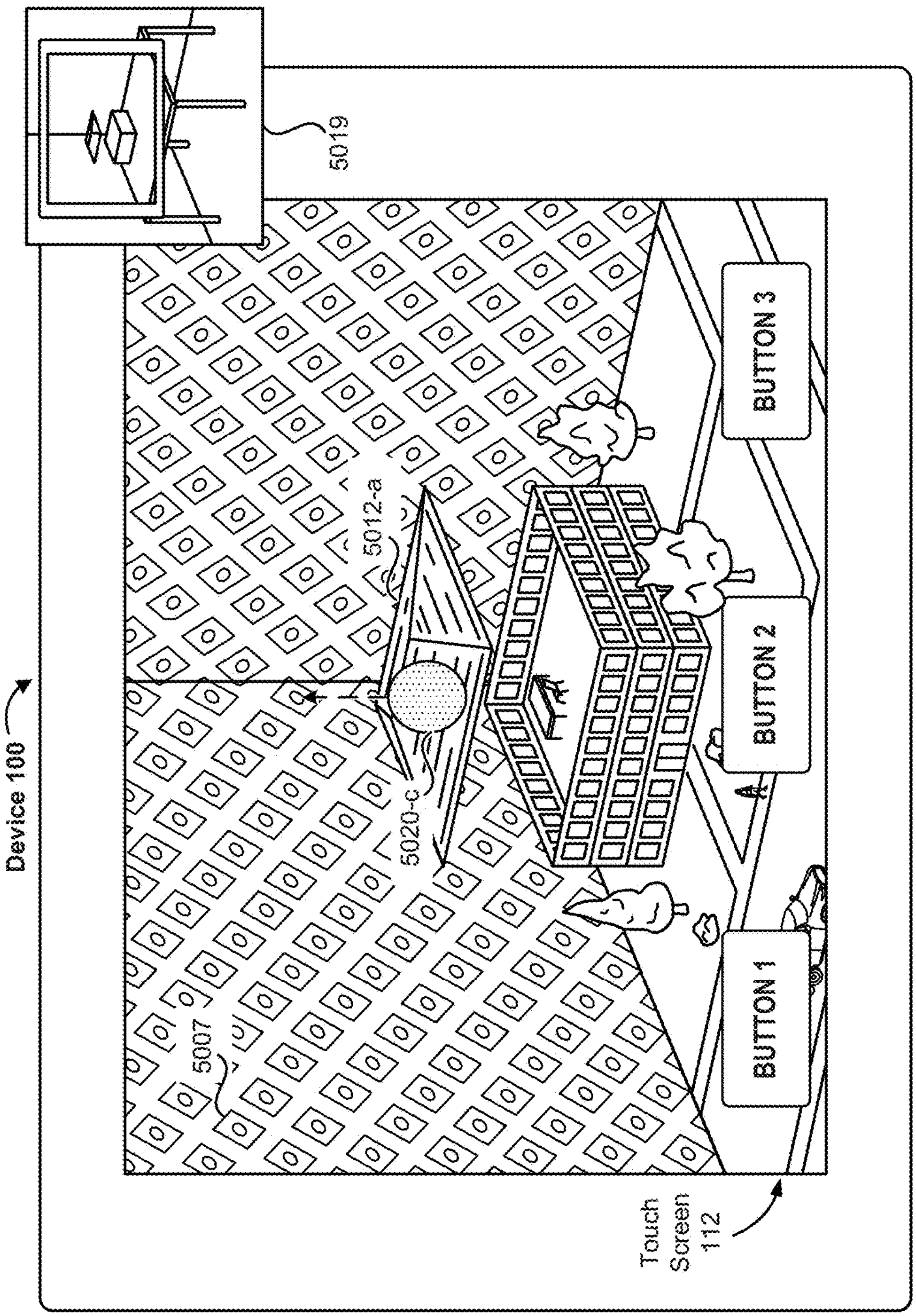
5012-a
5020-b
5007
BUTTON 1
BUTTON 2
BUTTON 3
Touch Screen 112

Figure 5A9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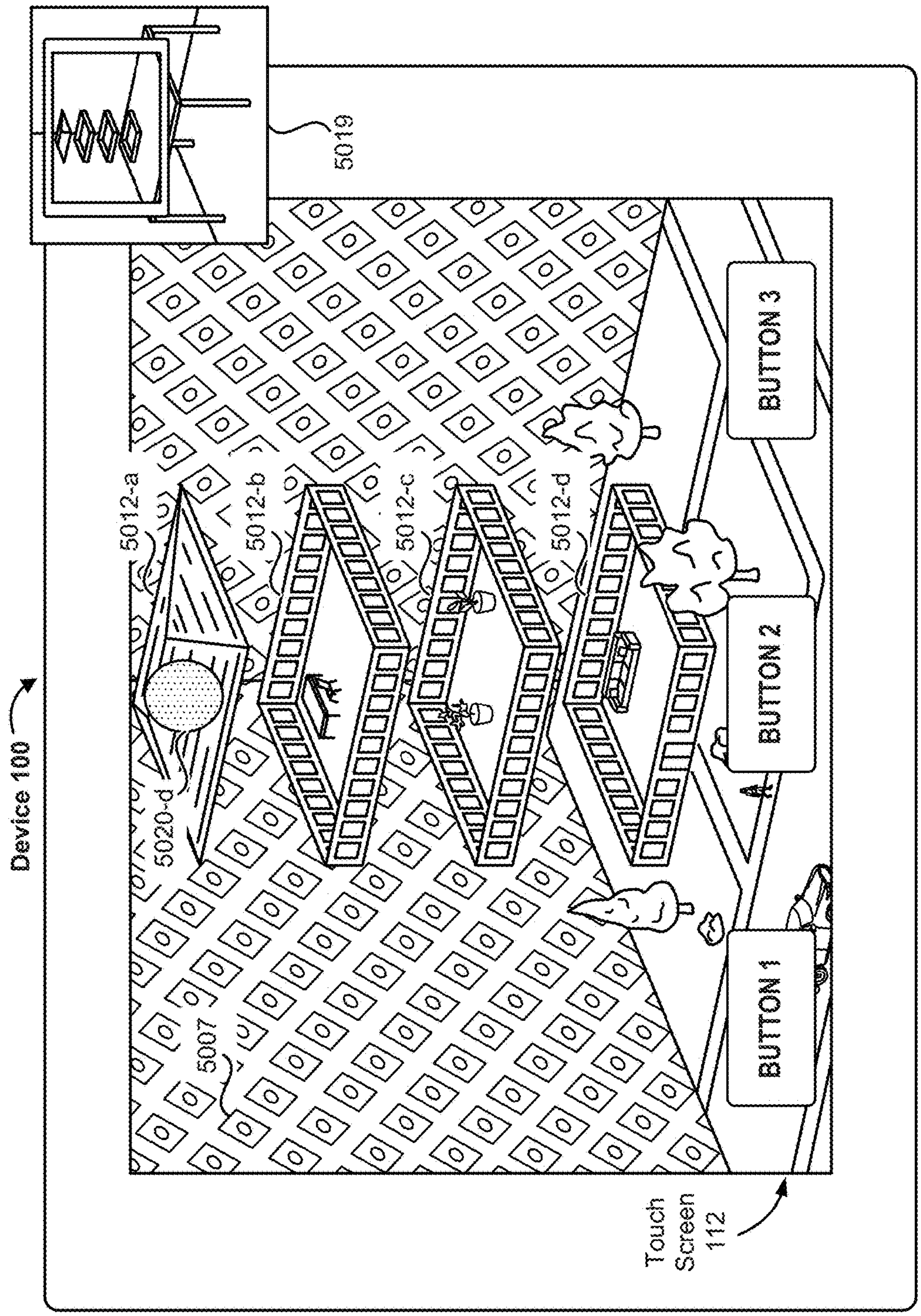
5012-a
5020-c
5007
BUTTON 1
BUTTON 2
BUTTON 3
Touch Screen 112

Figure 5A10


Device 100
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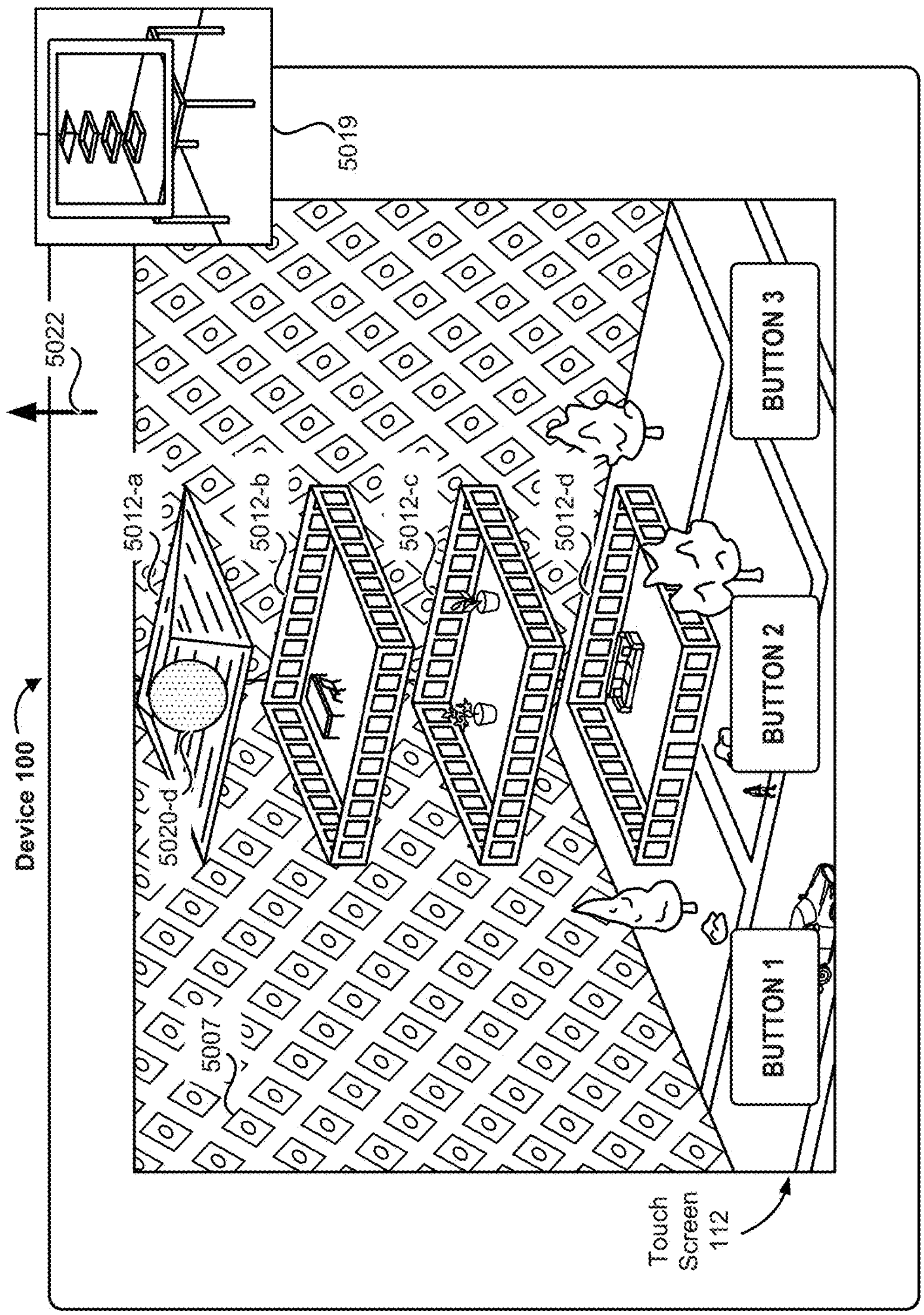
5012-a
5012-b
5012-c
5012-d
5020-d
5007
BUTTON 1
BUTTON 2
BUTTON 3
Touch Screen 112

Figure 5A11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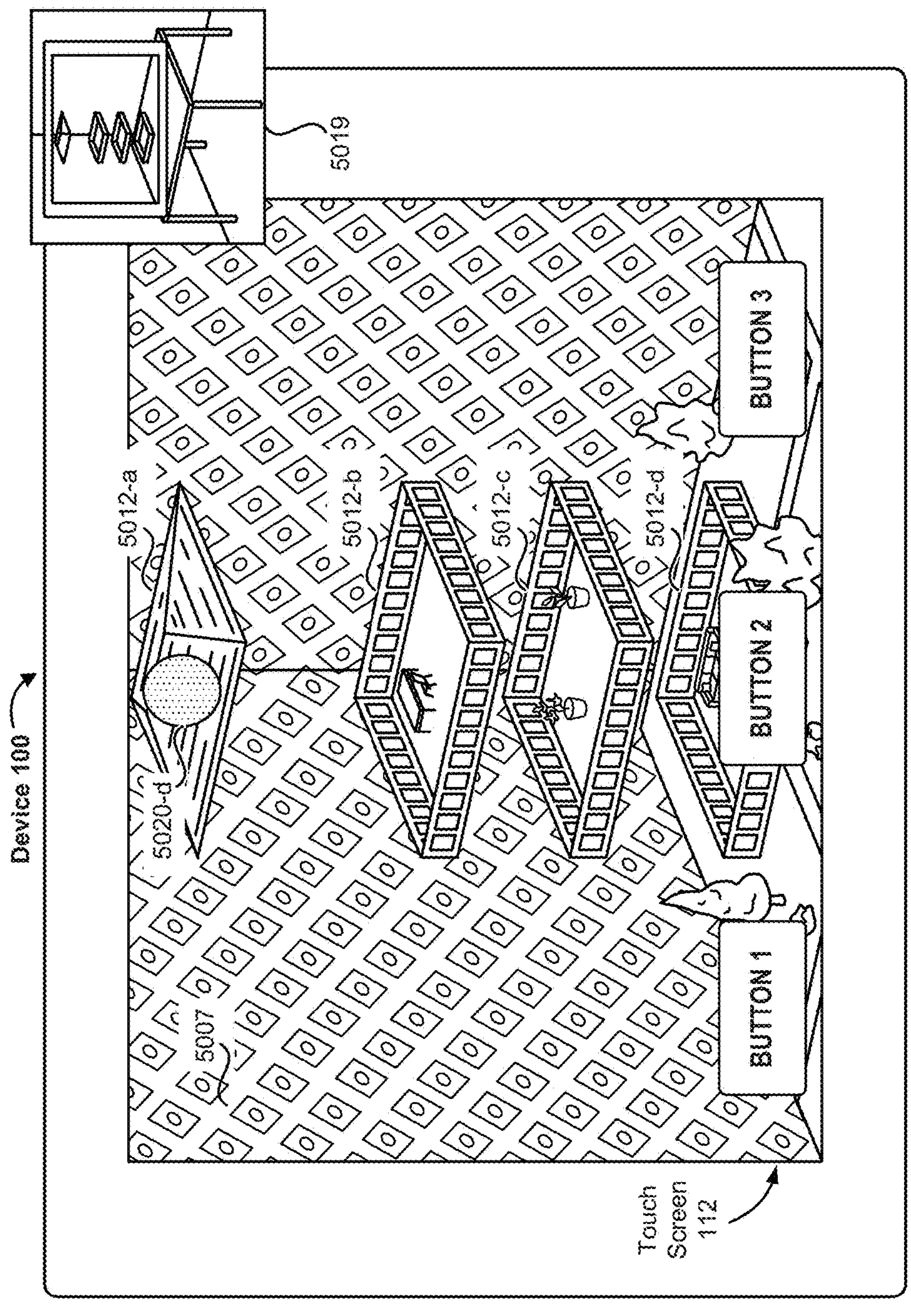
5022
5019
5012-a
5012-b
5012-c
5012-d
5020-d
5007
BUTTON 1
BUTTON 2
BUTTON 3
Touch Screen 112

Figure 5A12


Device 100
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5012-a
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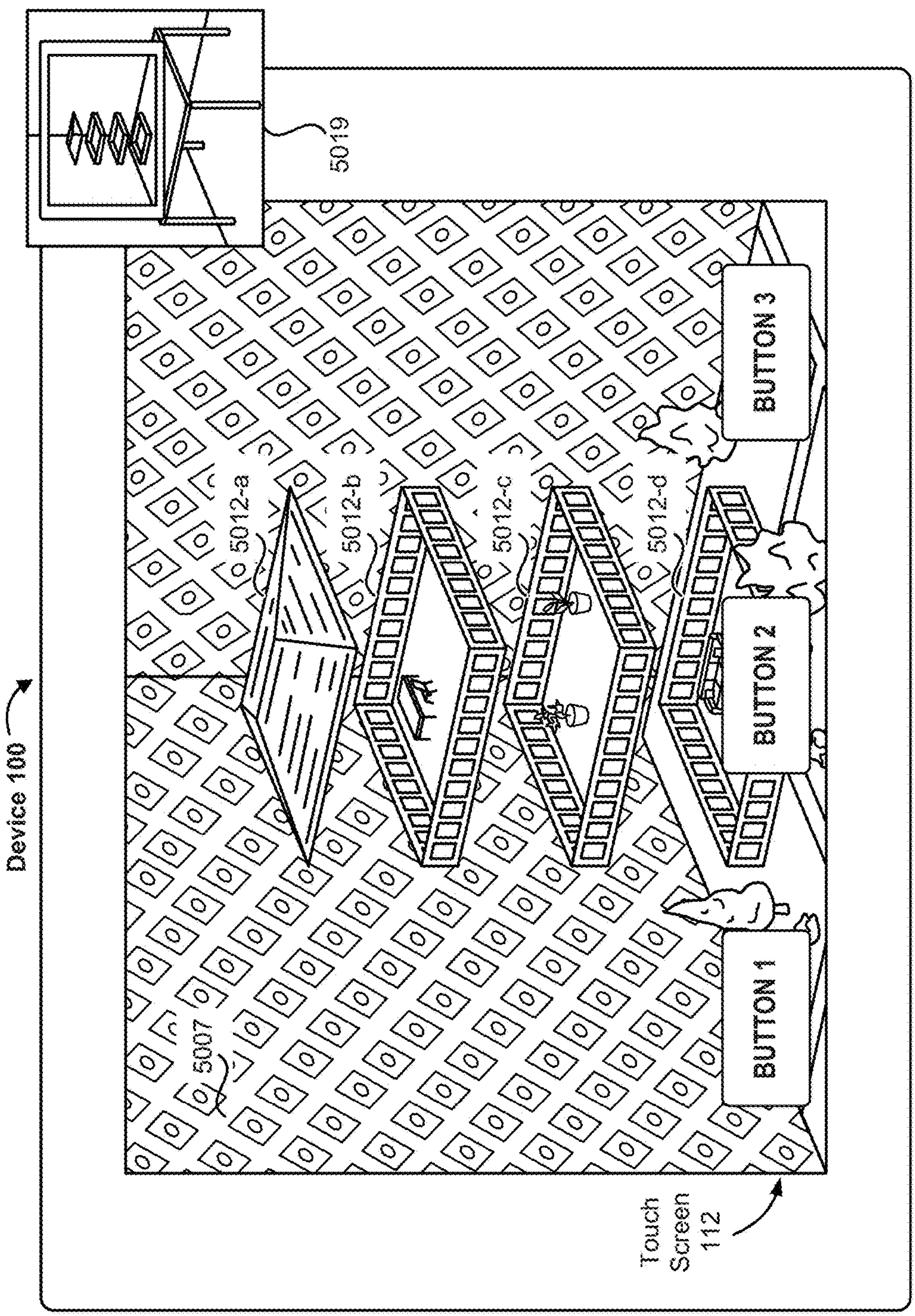
5012-c
5012-d
5020-d
5007
BUTTON 1
BUTTON 2
BUTTON 3
Touch Screen 112

Figure 5A13



Device 100
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5012-a
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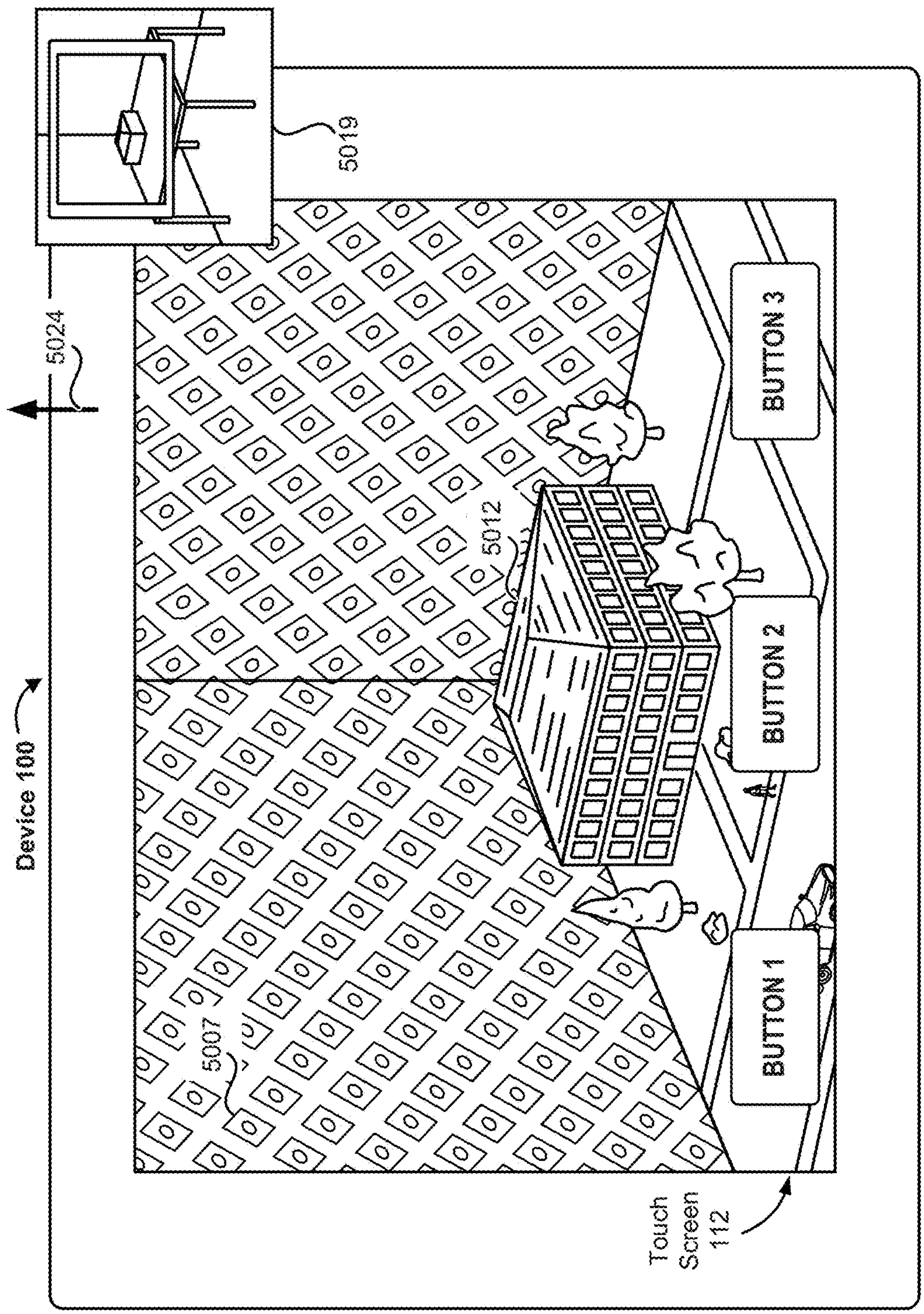
5012-c
5012-d
BUTTON 1
BUTTON 2
BUTTON 3
5007
Touch Screen 112

Figure 5A14



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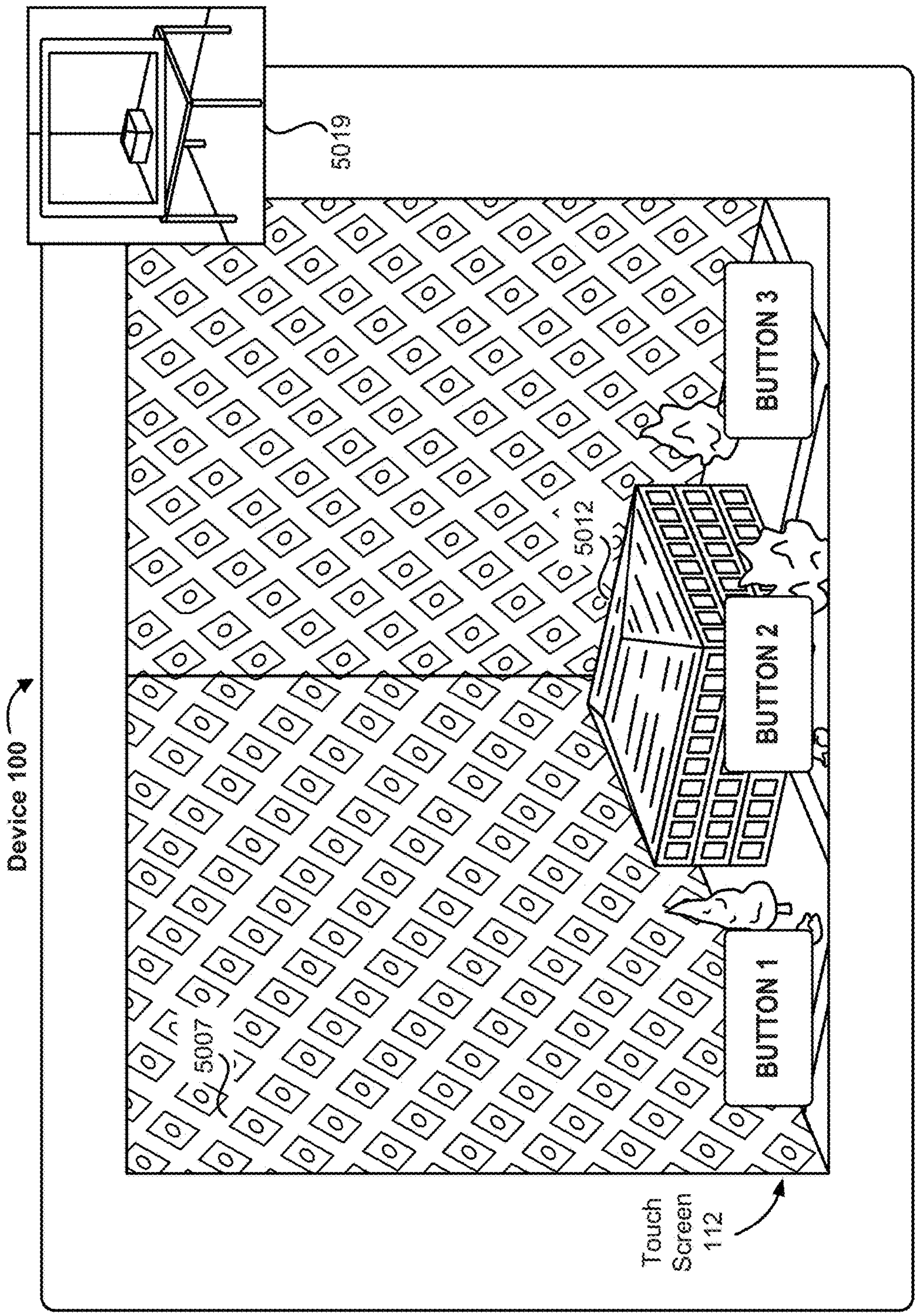
BUTTON 1
BUTTON 2
BUTTON 3
Touch Screen 112

Figure 5A15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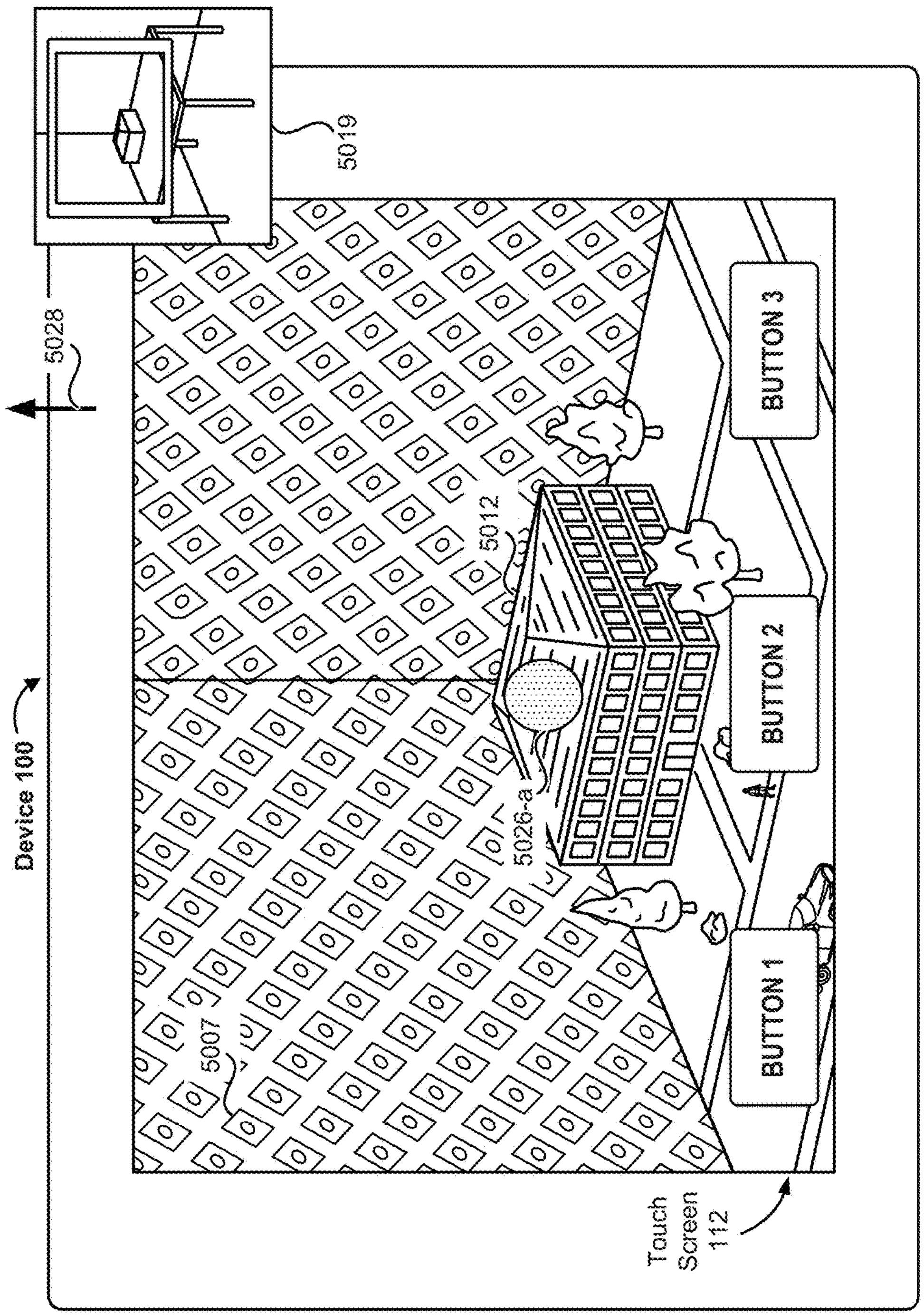
BUTTON 2
BUTTON 3
Touch Screen 112

Figure 5A16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BUTTON 3
Touch Screen 112

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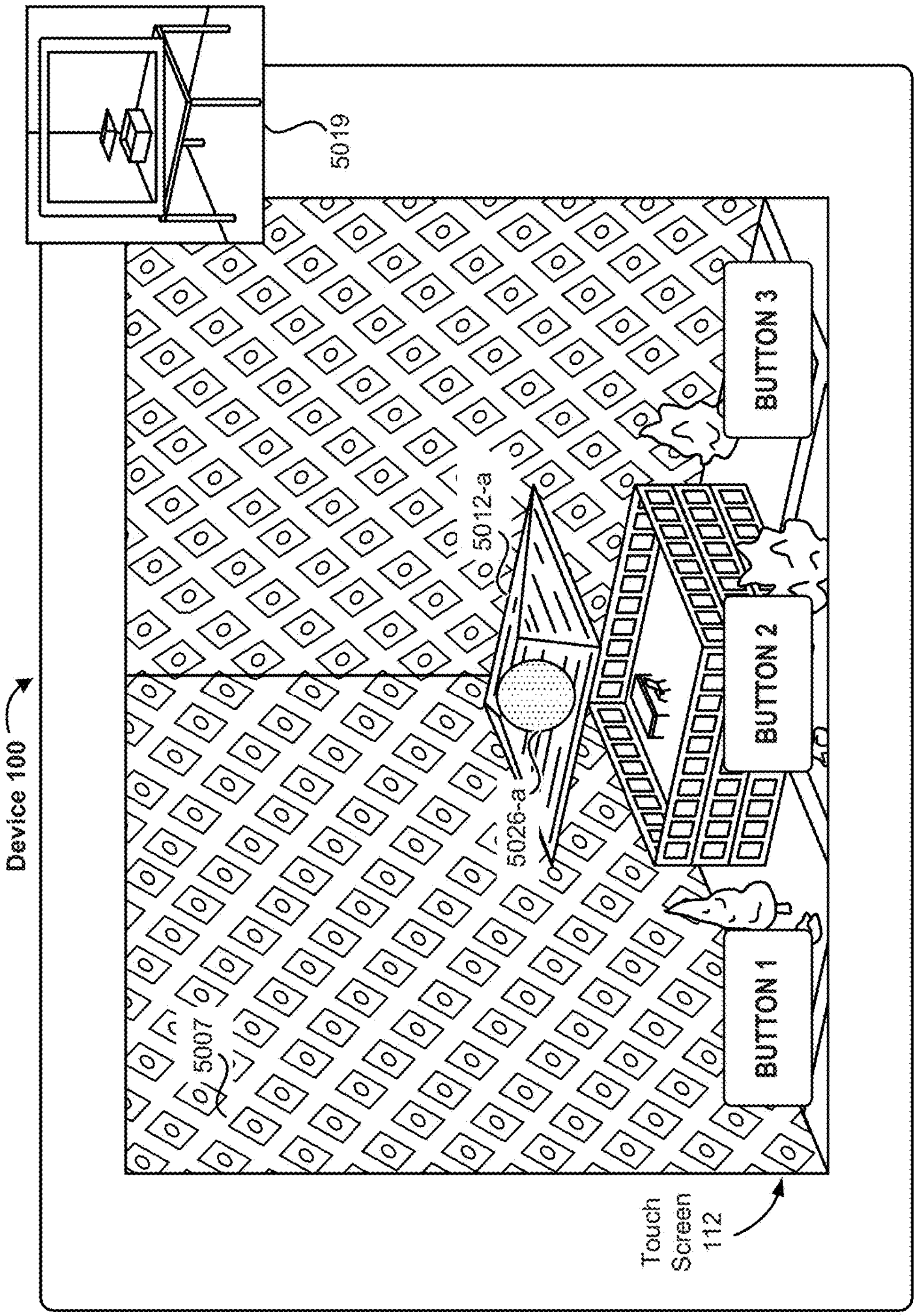

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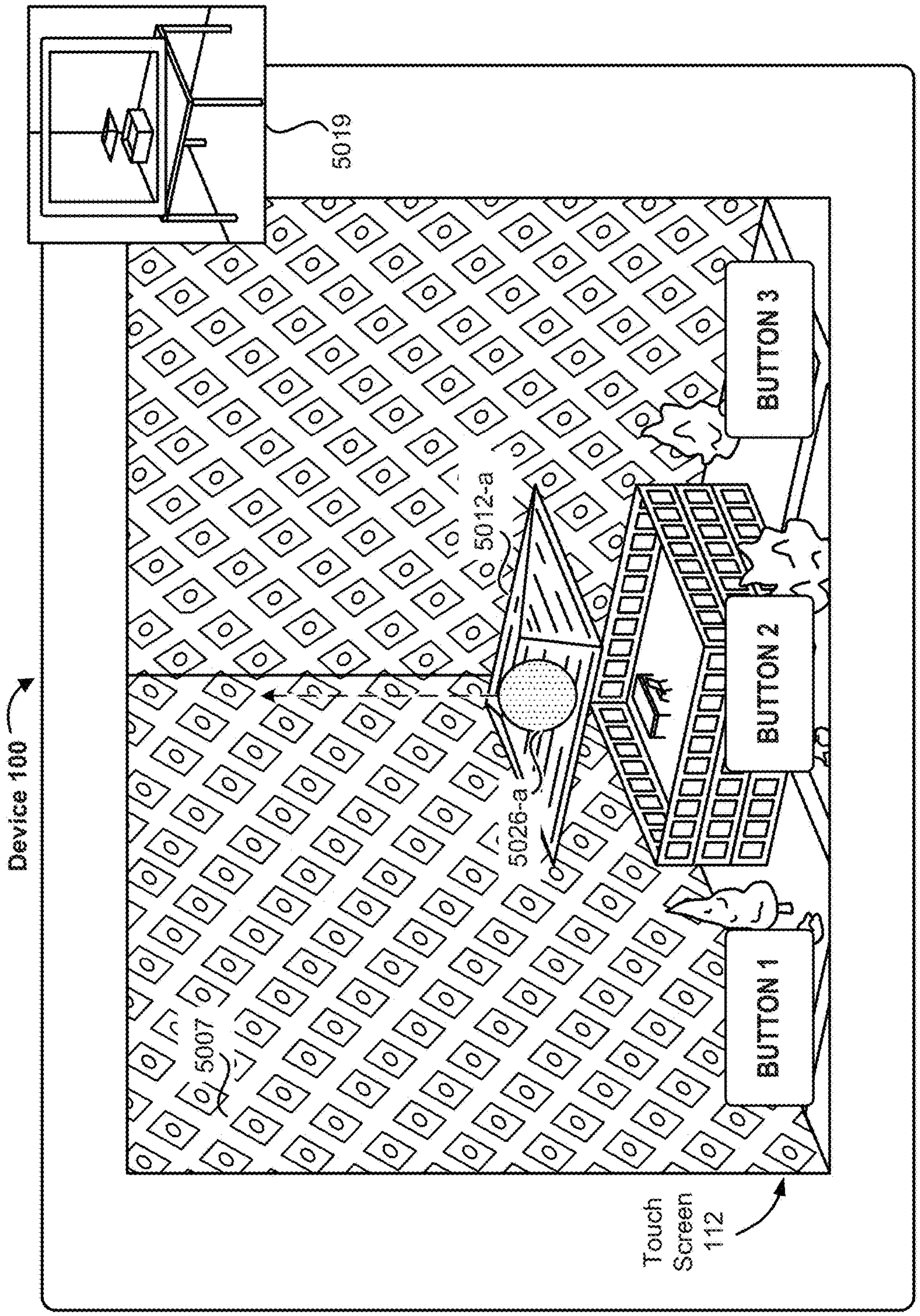
5007
BUTTON 1
BUTTON 2
BUTTON 3
Touch Screen 112

Figure 5A18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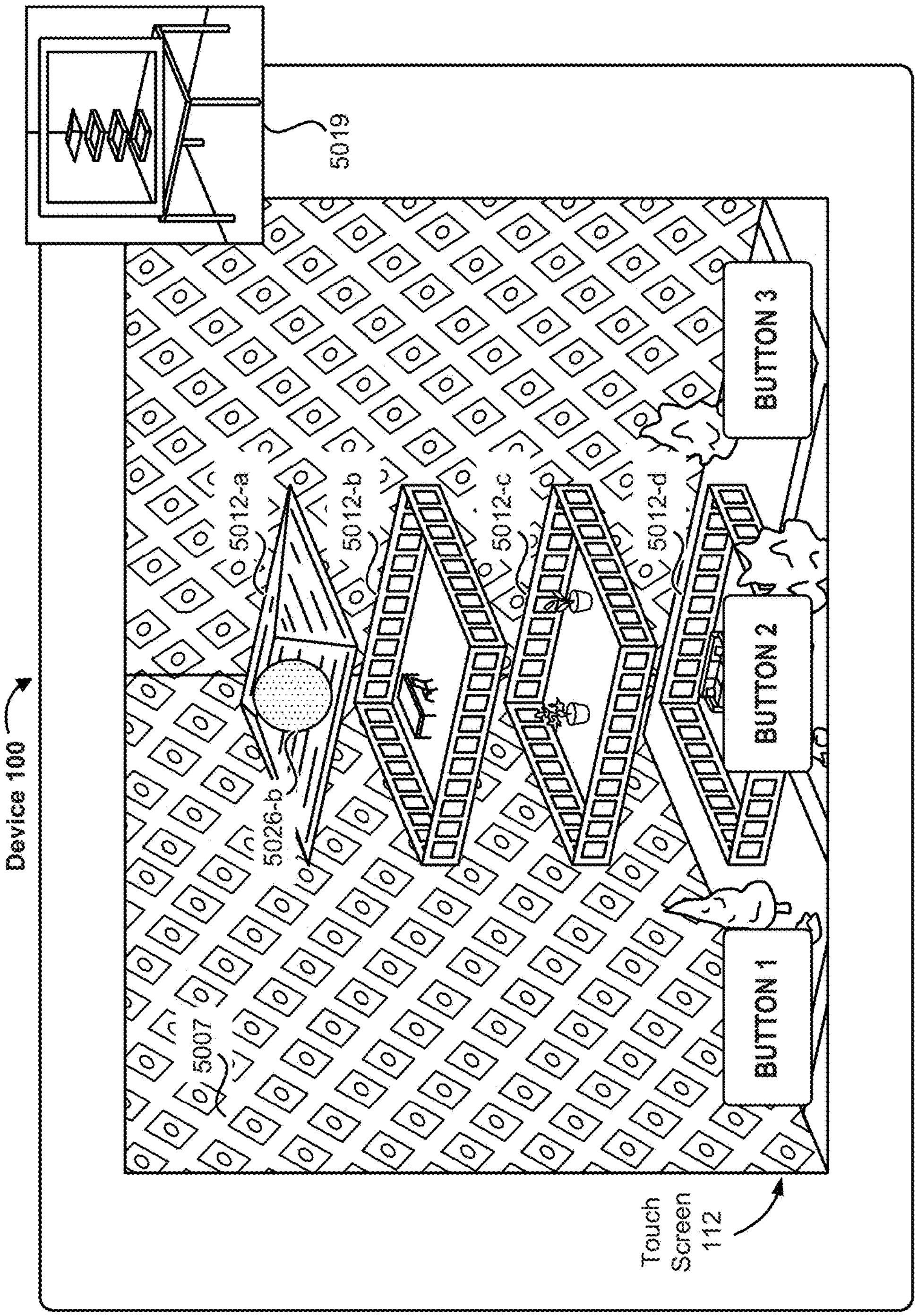
5026-a
5007
BUTTON 1
BUTTON 2
BUTTON 3
Touch Screen 112

Figure 5A19


Device 100
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5012-d
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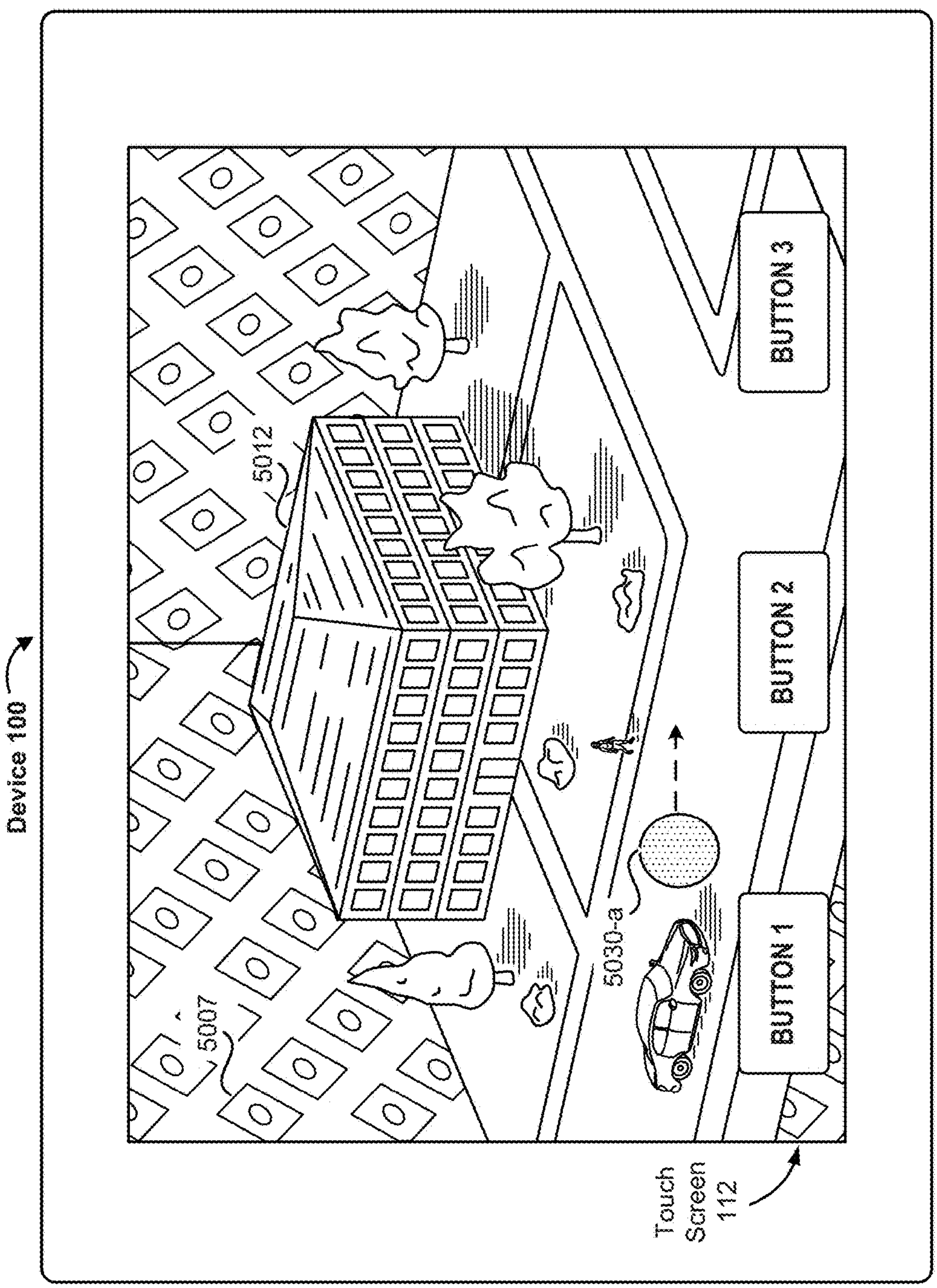
5007
BUTTON 1
BUTTON 2
BUTTON 3
Touch Screen 112

Figure 5A20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5007
5030-a
BUTTON 1
BUTTON 2
BUTTON 3
Touch Screen 112

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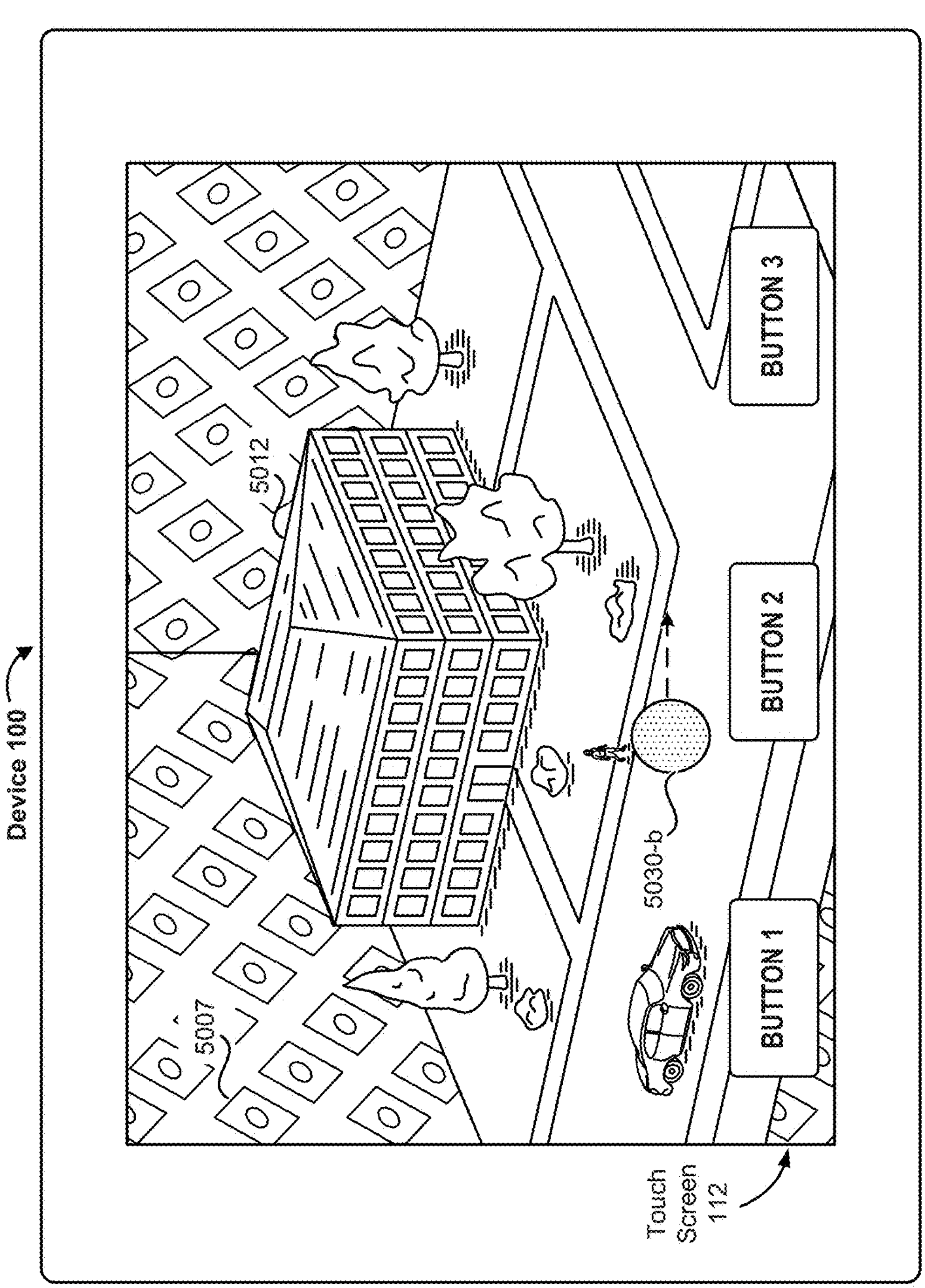
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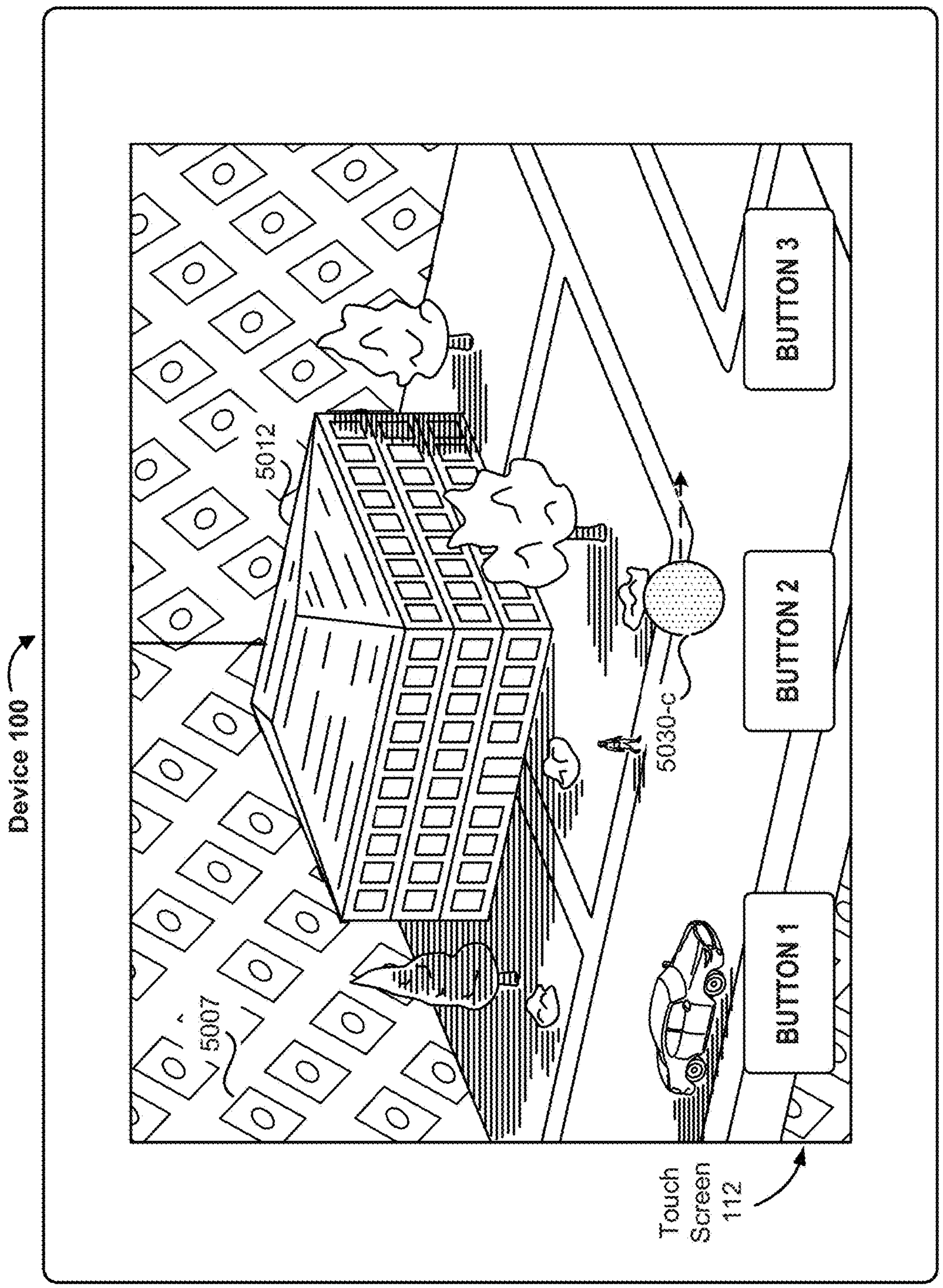
5012
5030-b
BUTTON 1
BUTTON 2
BUTTON 3
Touch Screen 112

Figure 5A22


Device 100
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5030-c
5007
BUTTON 1
BUTTON 2
BUTTON 3
Touch Screen 112

Figure 5A23

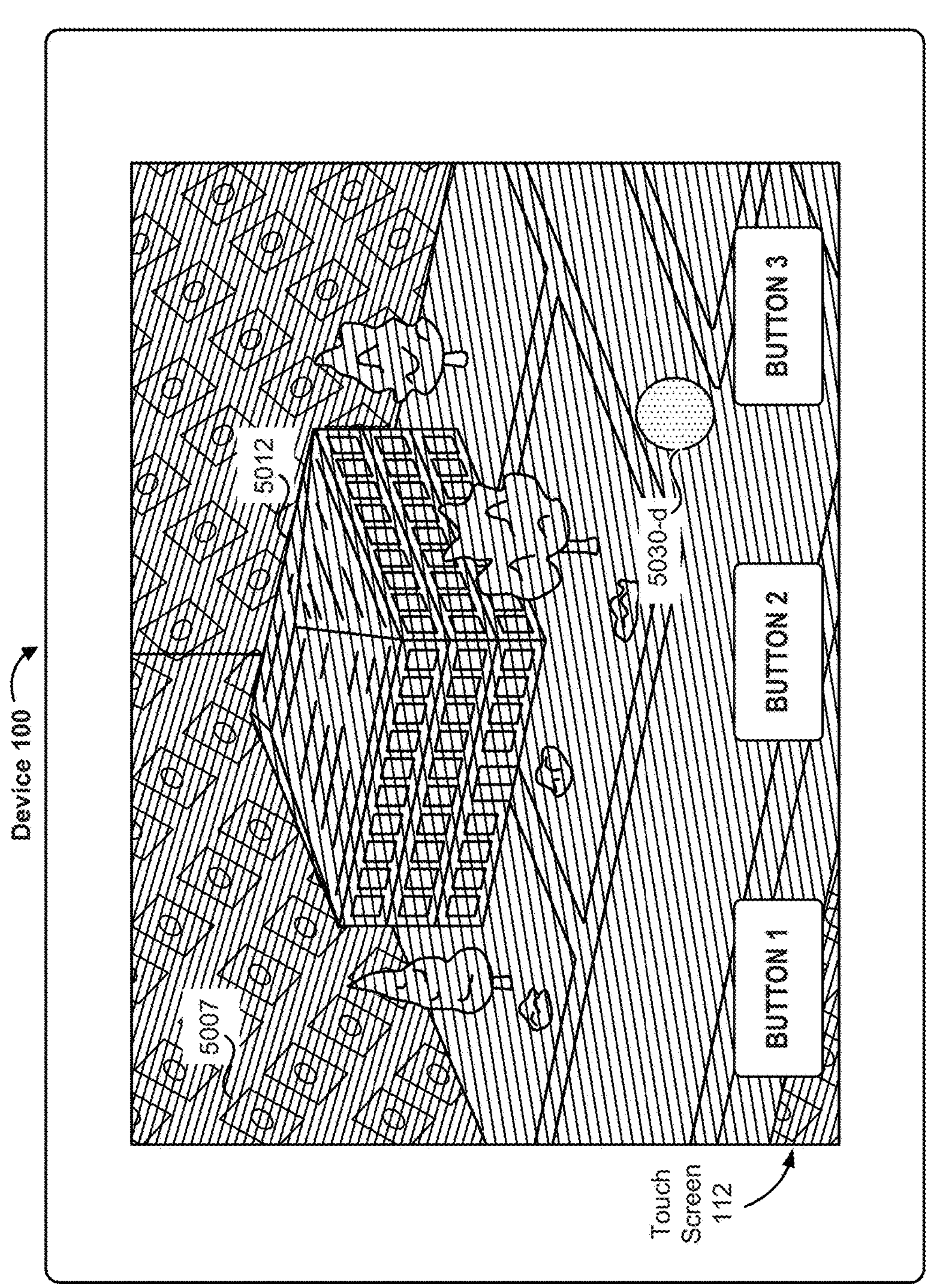

Device 100
5012
5030-d
5007
BUTTON 1
BUTTON 2
BUTTON 3
Touch Screen 112

Figure 5A24

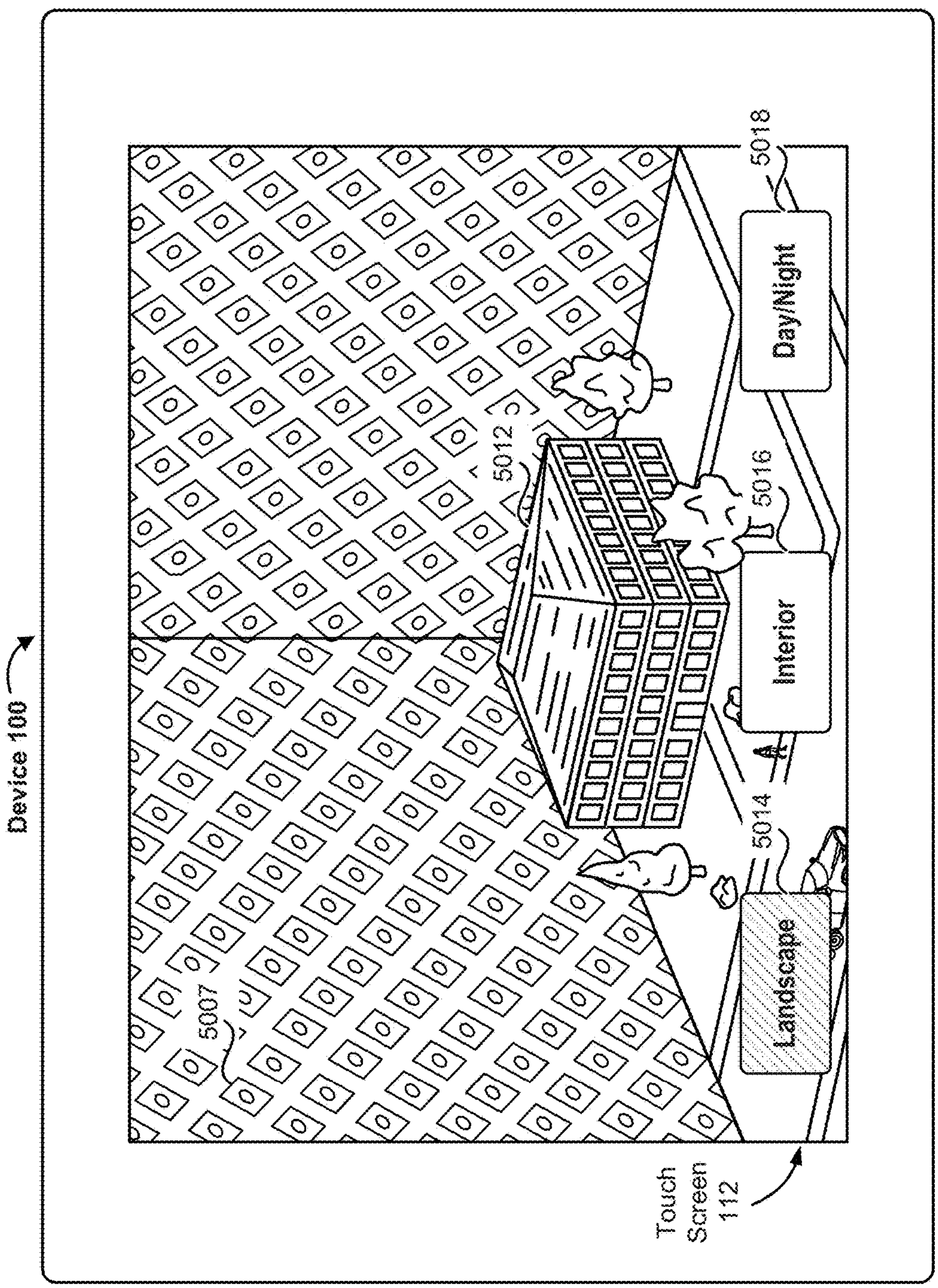
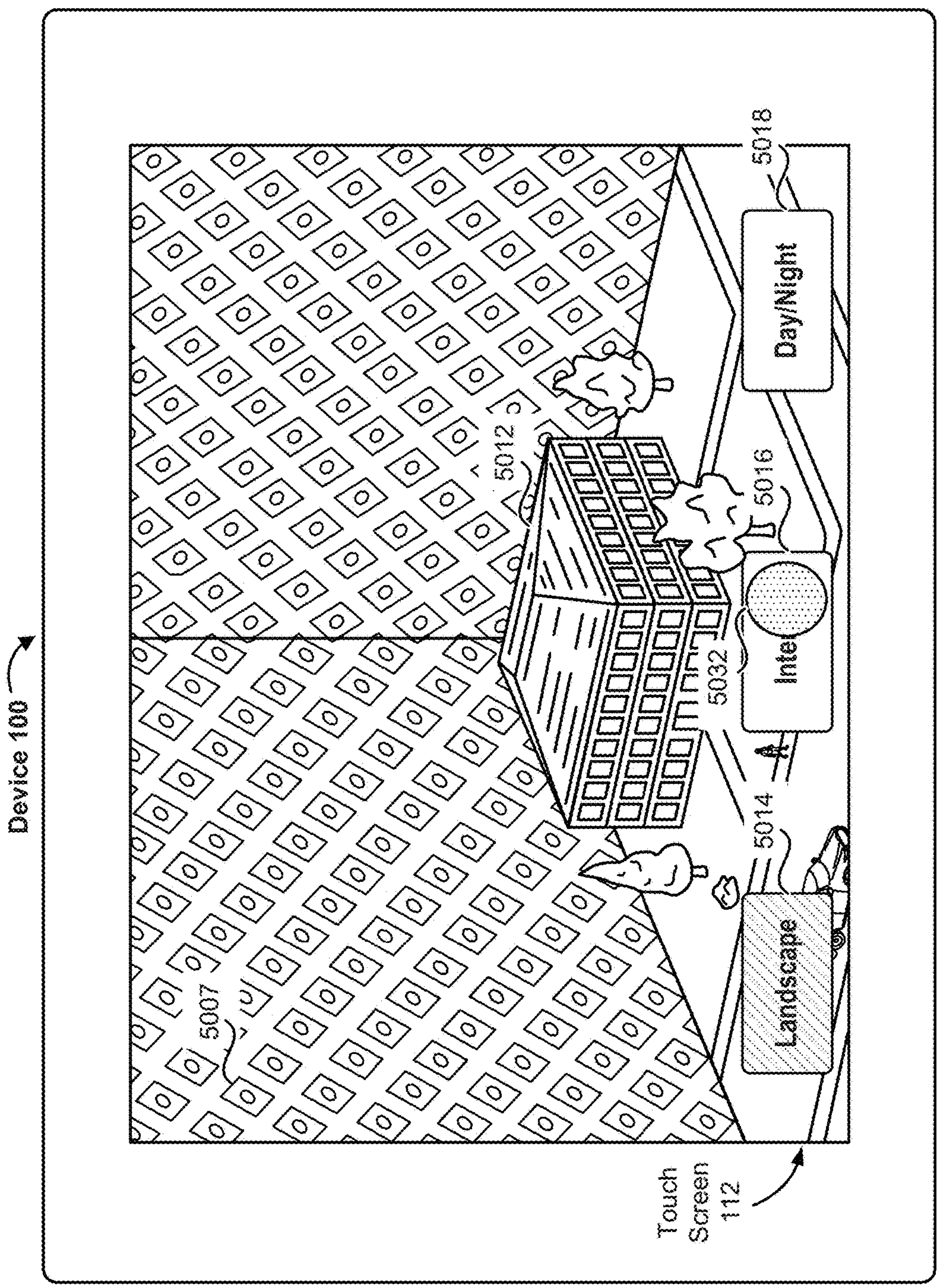

Device 100
5007
5012
5014
5016
5018
Landscape
Interior
Day/Night
Touch Screen 112

Figure 5A25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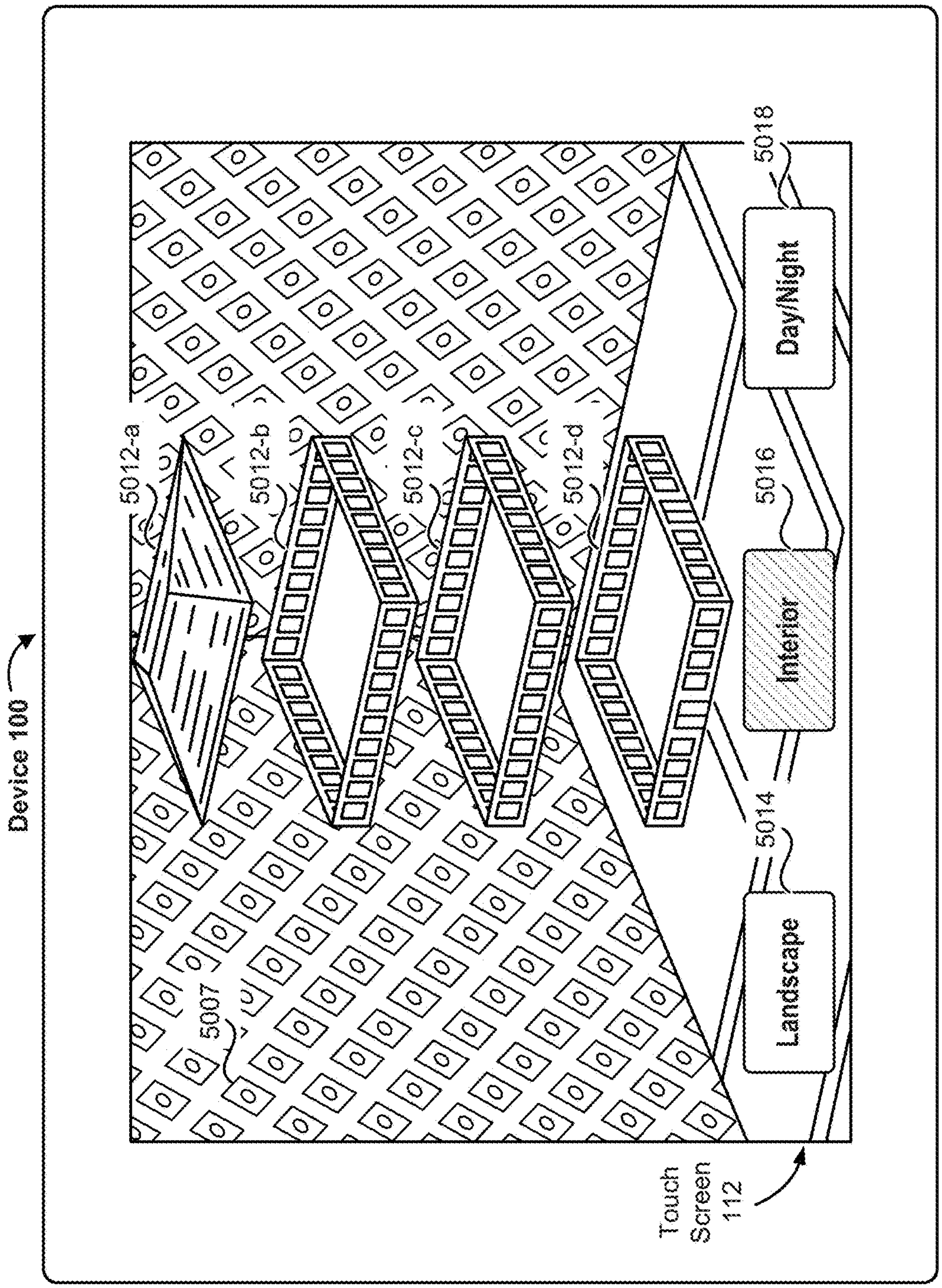
5007
5012
5016
5018
Day/Night
5032
Inte
5014
Landscape
Touch Screen 112

Figure 5A26


Device 100
5012-a
5012-b
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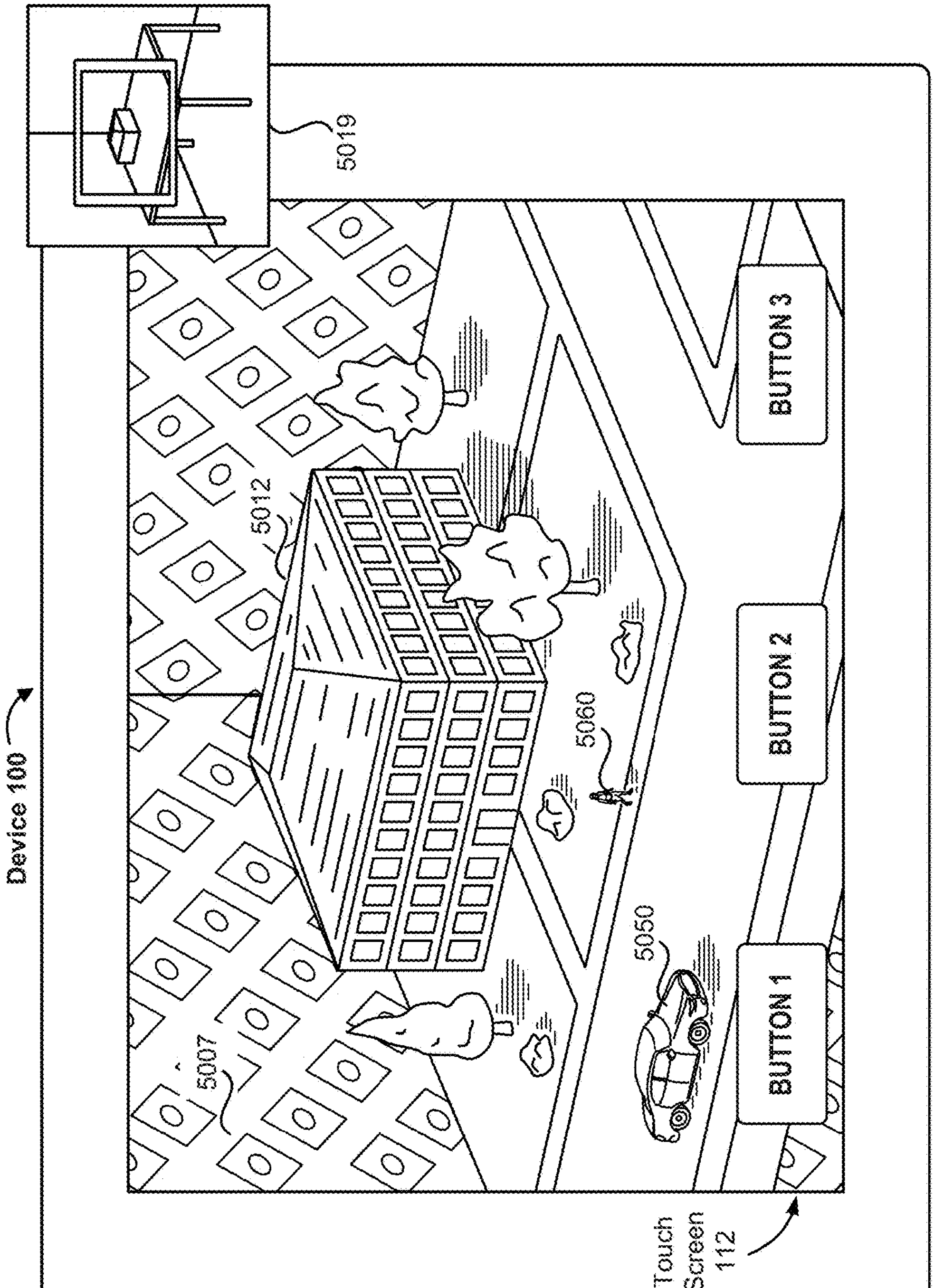
5012-d
5007
Landscape
Interior
Day/Night
5014
5016
5018
Touch Screen 112

Figure 5A27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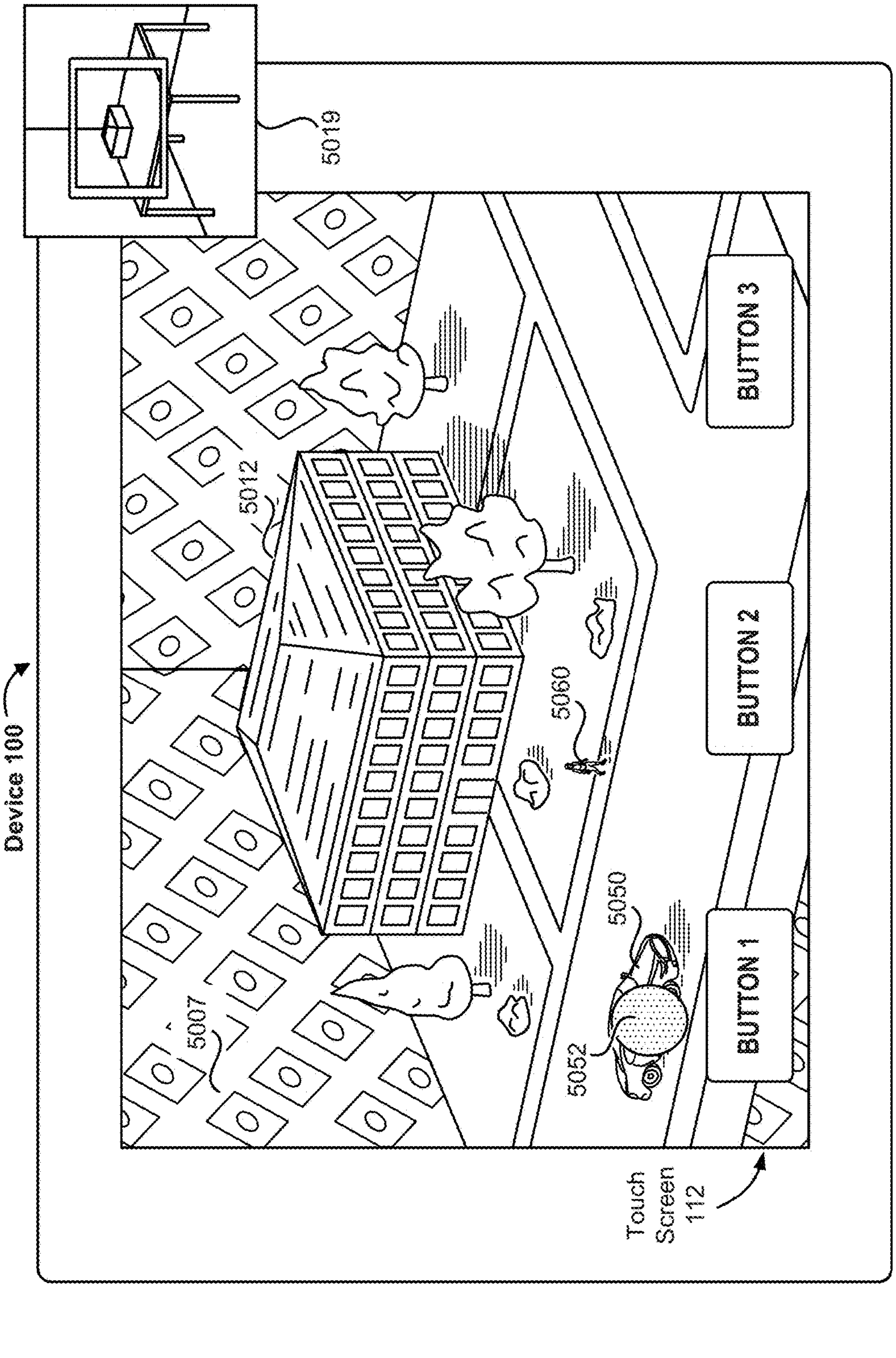
5060
5050
5007
BUTTON 1
BUTTON 2
BUTTON 3
Touch Screen 112

Figure 5A28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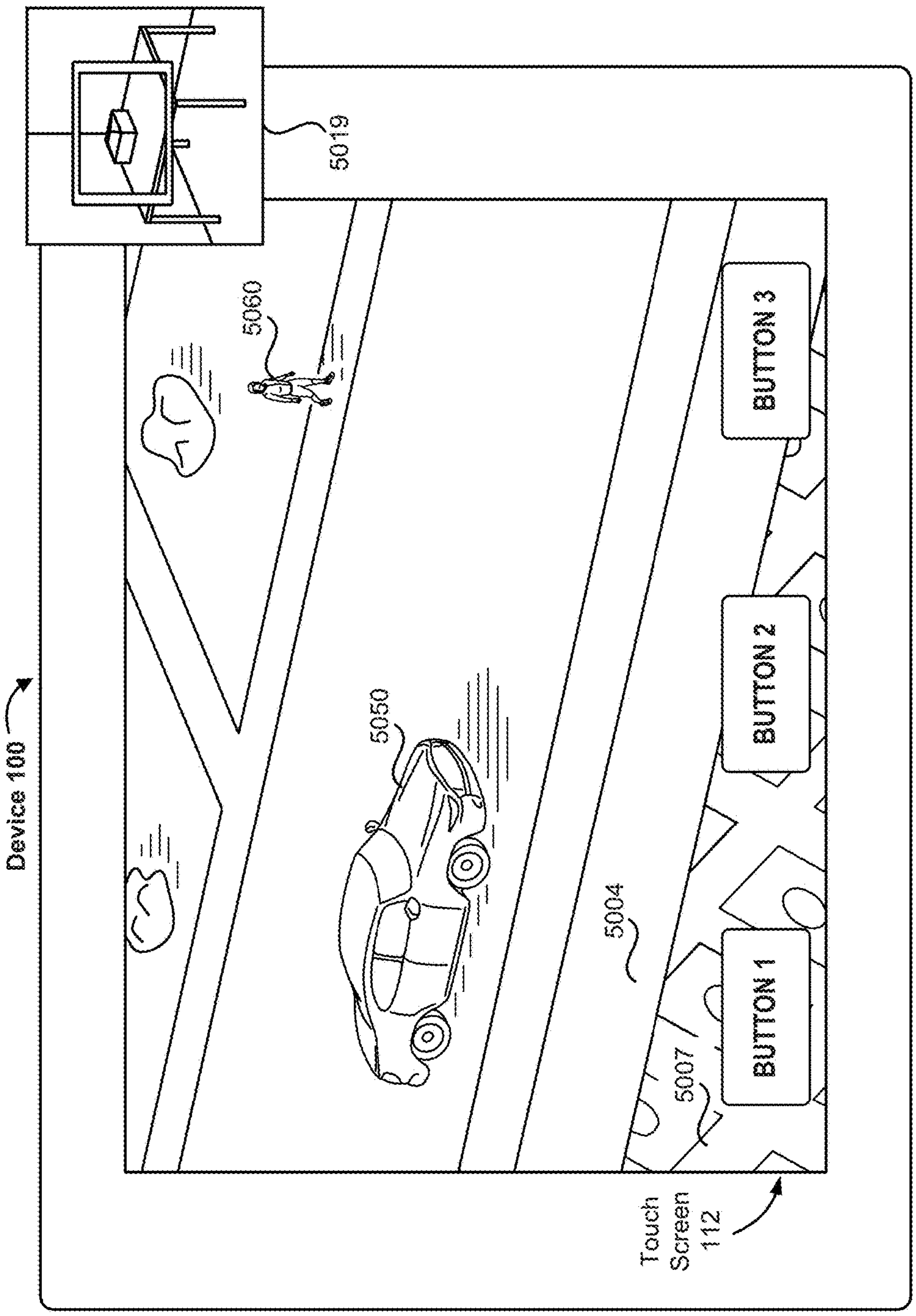
5052
BUTTON 1
BUTTON 2
BUTTON 3
Touch Screen 112

Figure 5A29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5007
BUTTON 1
BUTTON 2
BUTTON 3
Touch Screen 112

Figure 5A30

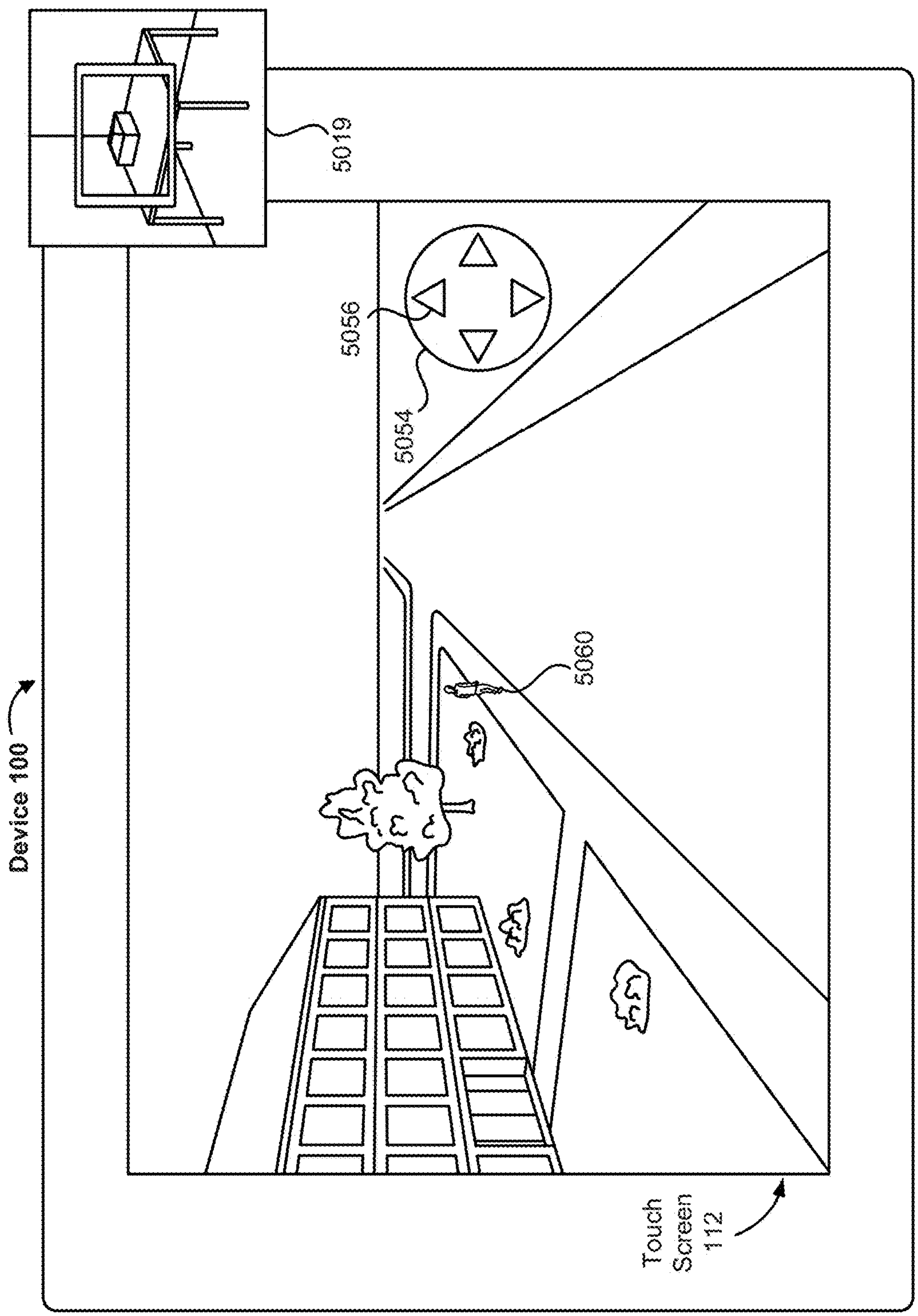


Figure 5A31

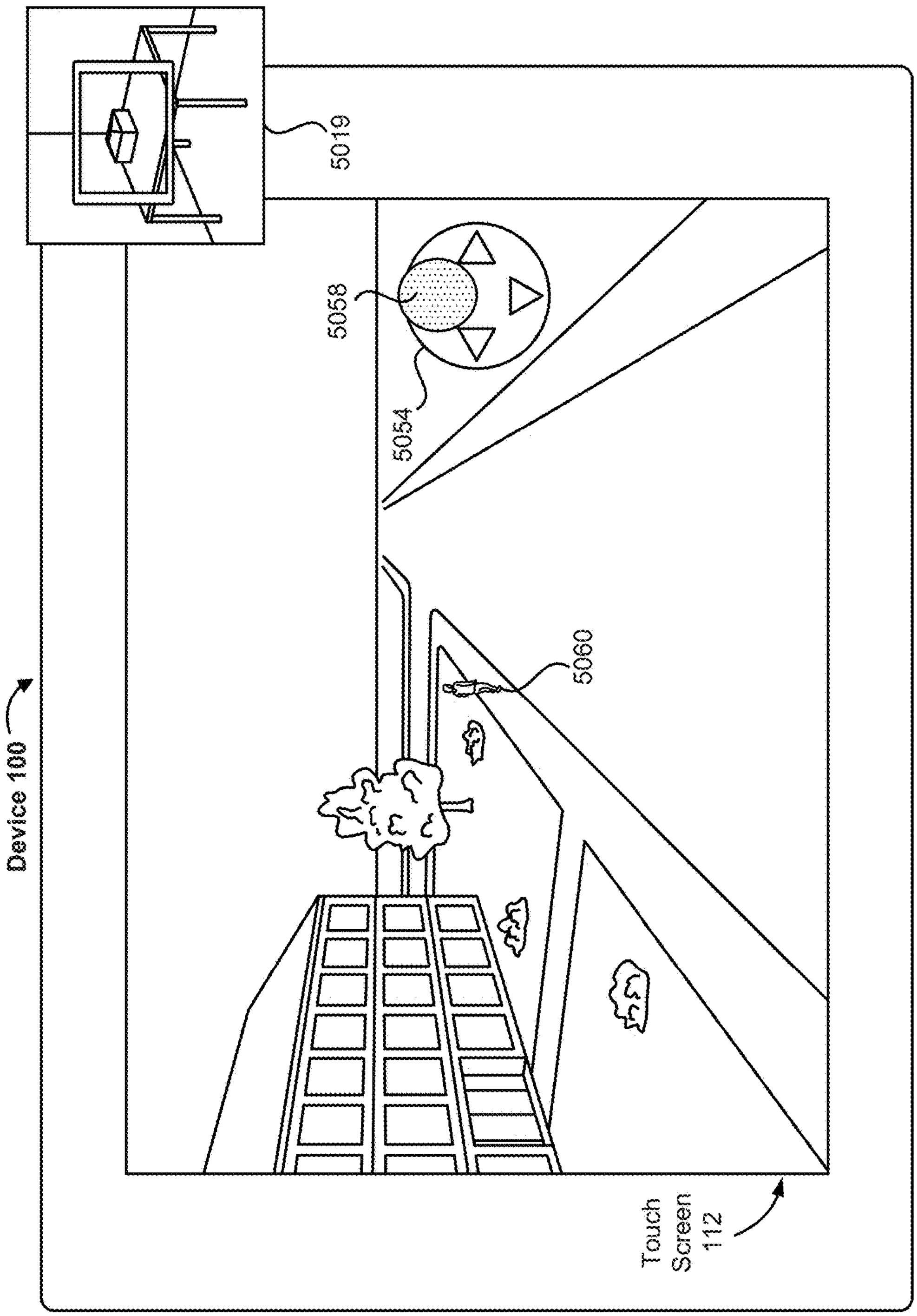
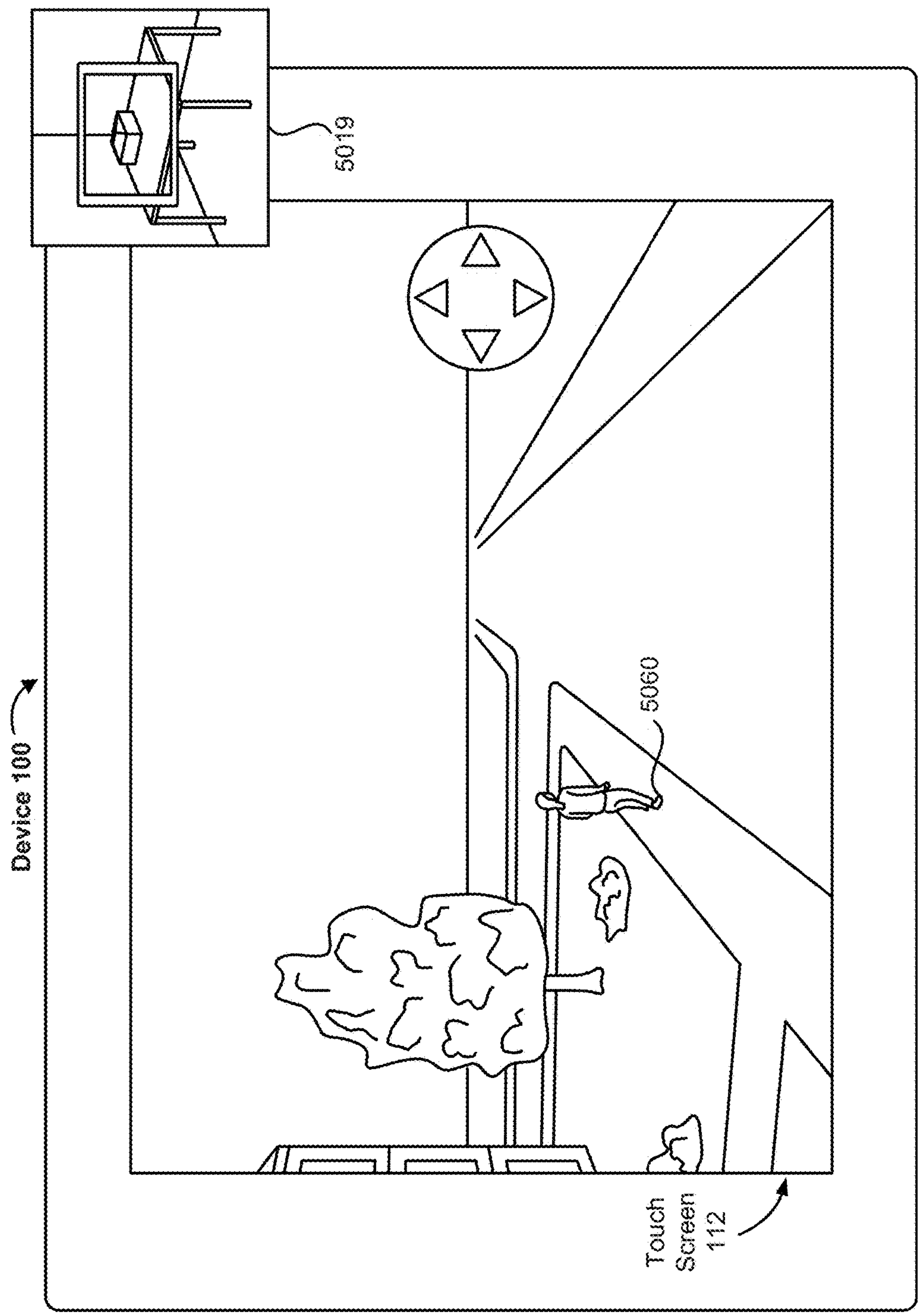


Figure 5A32



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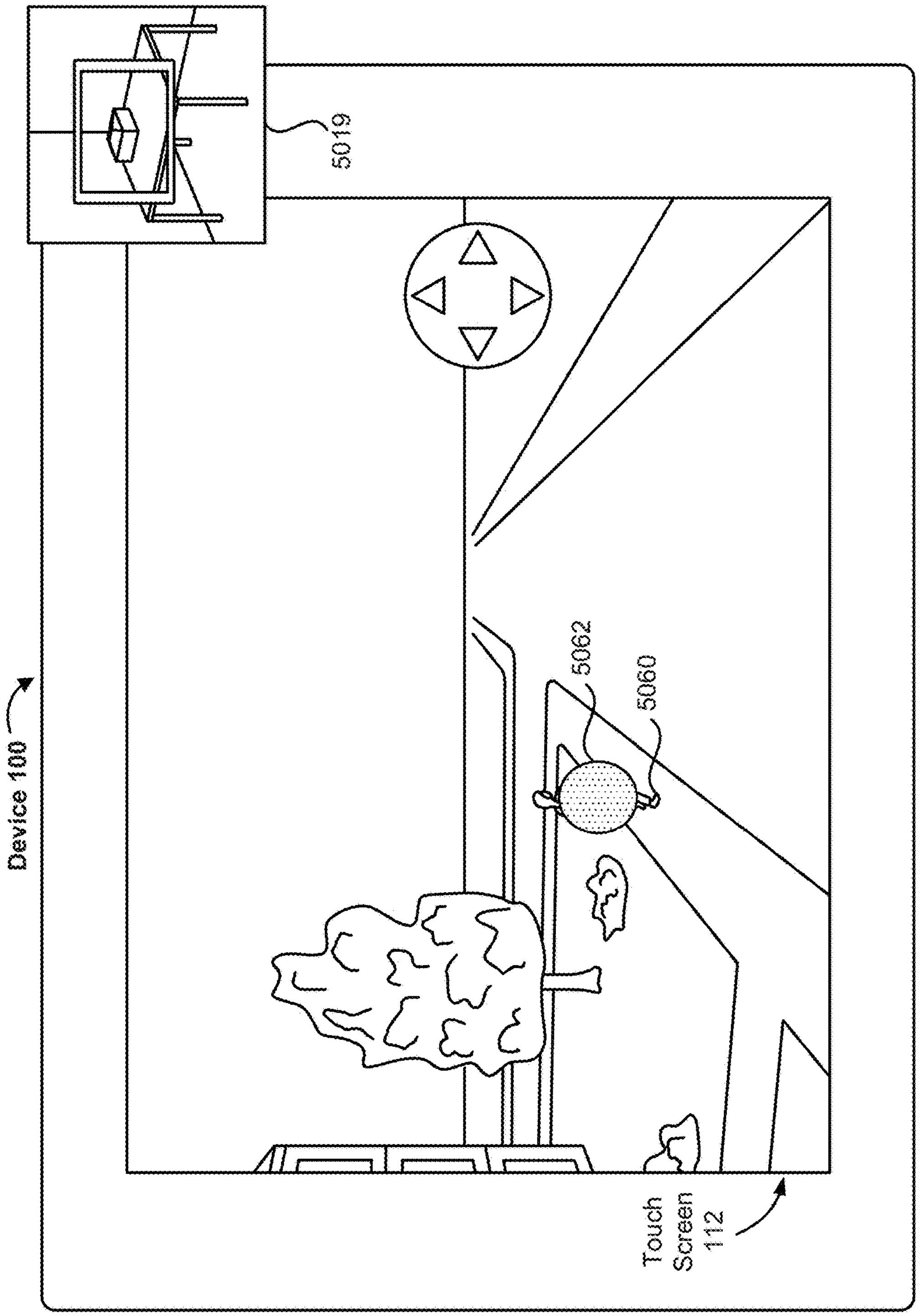

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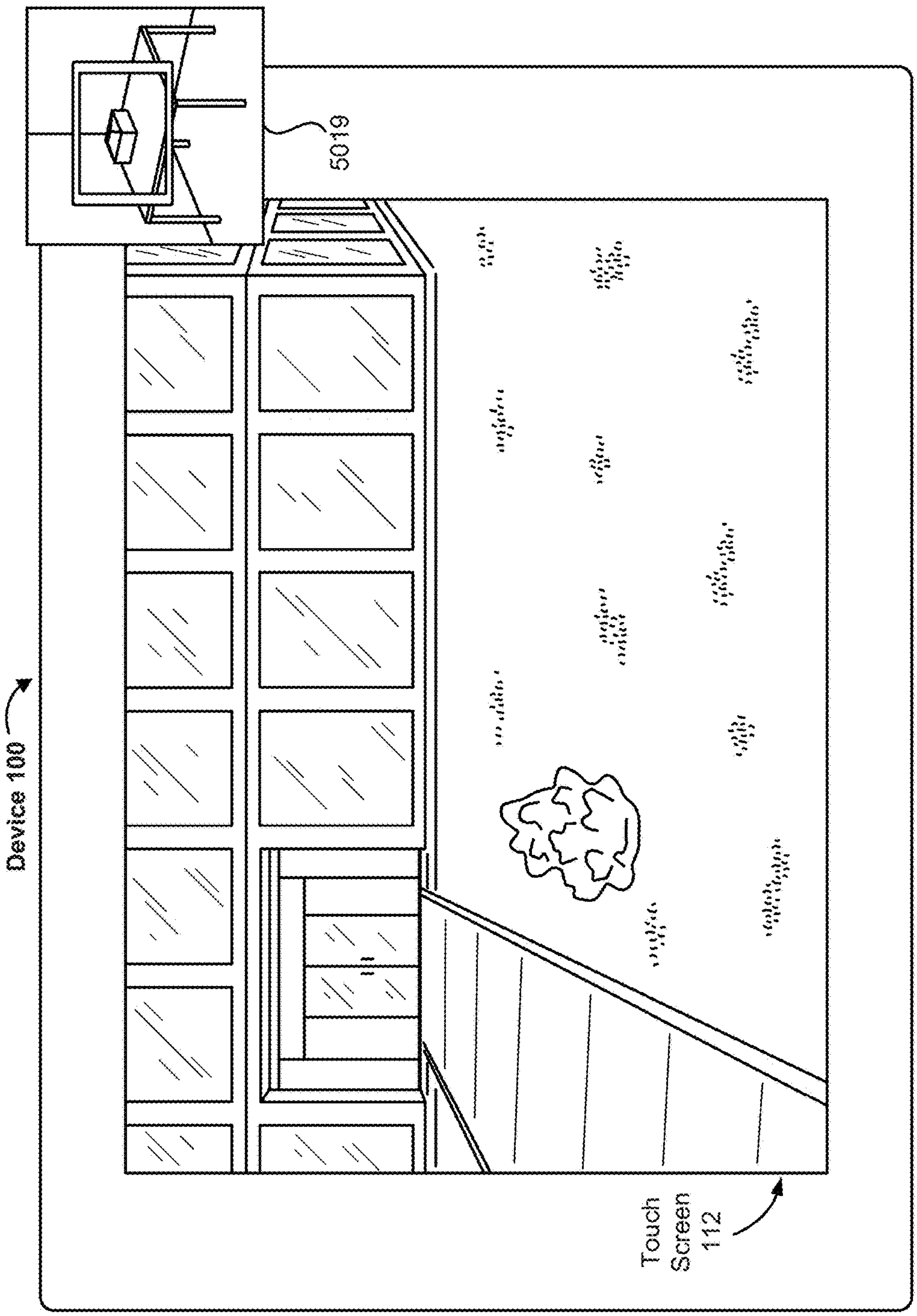

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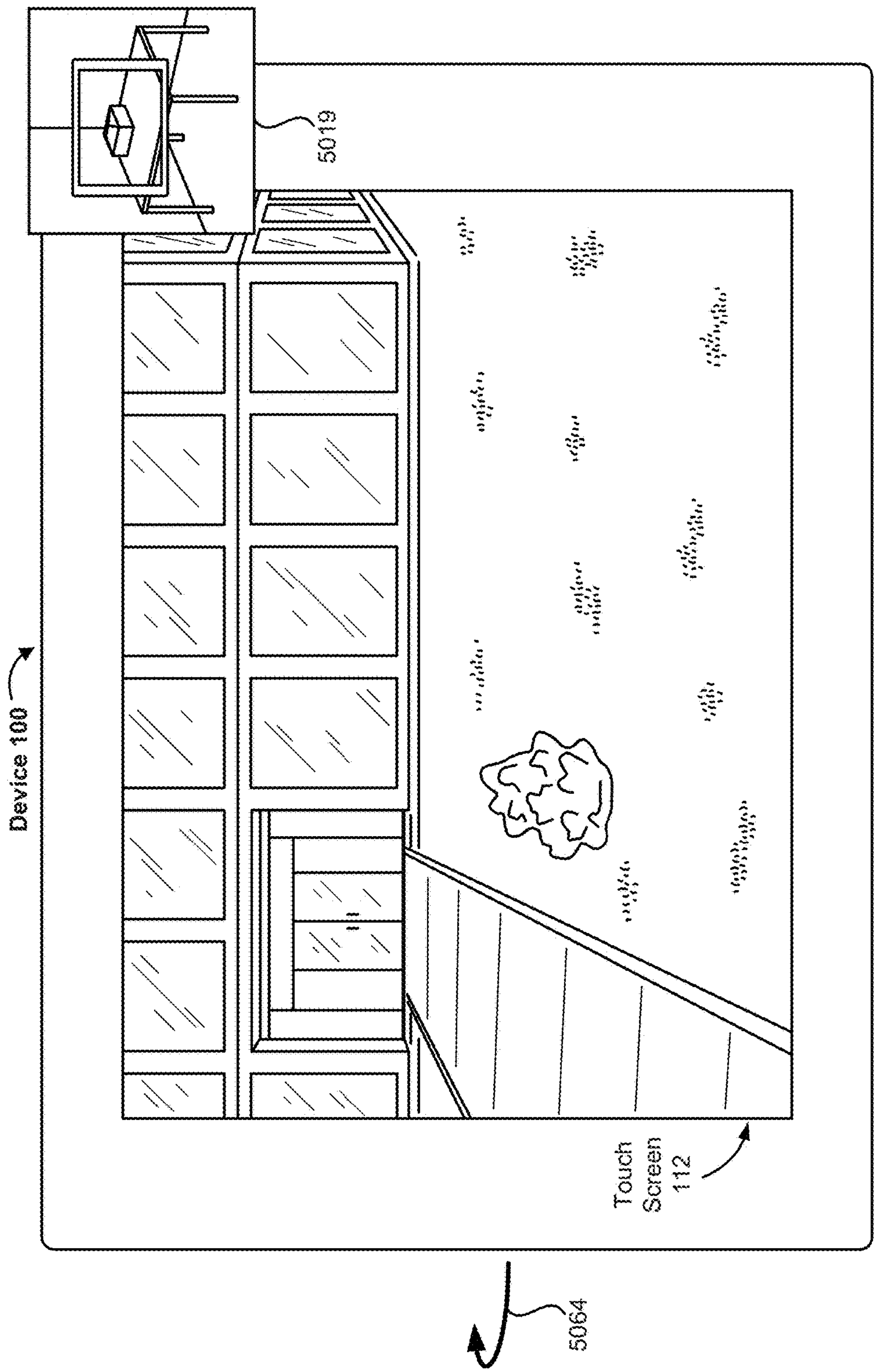

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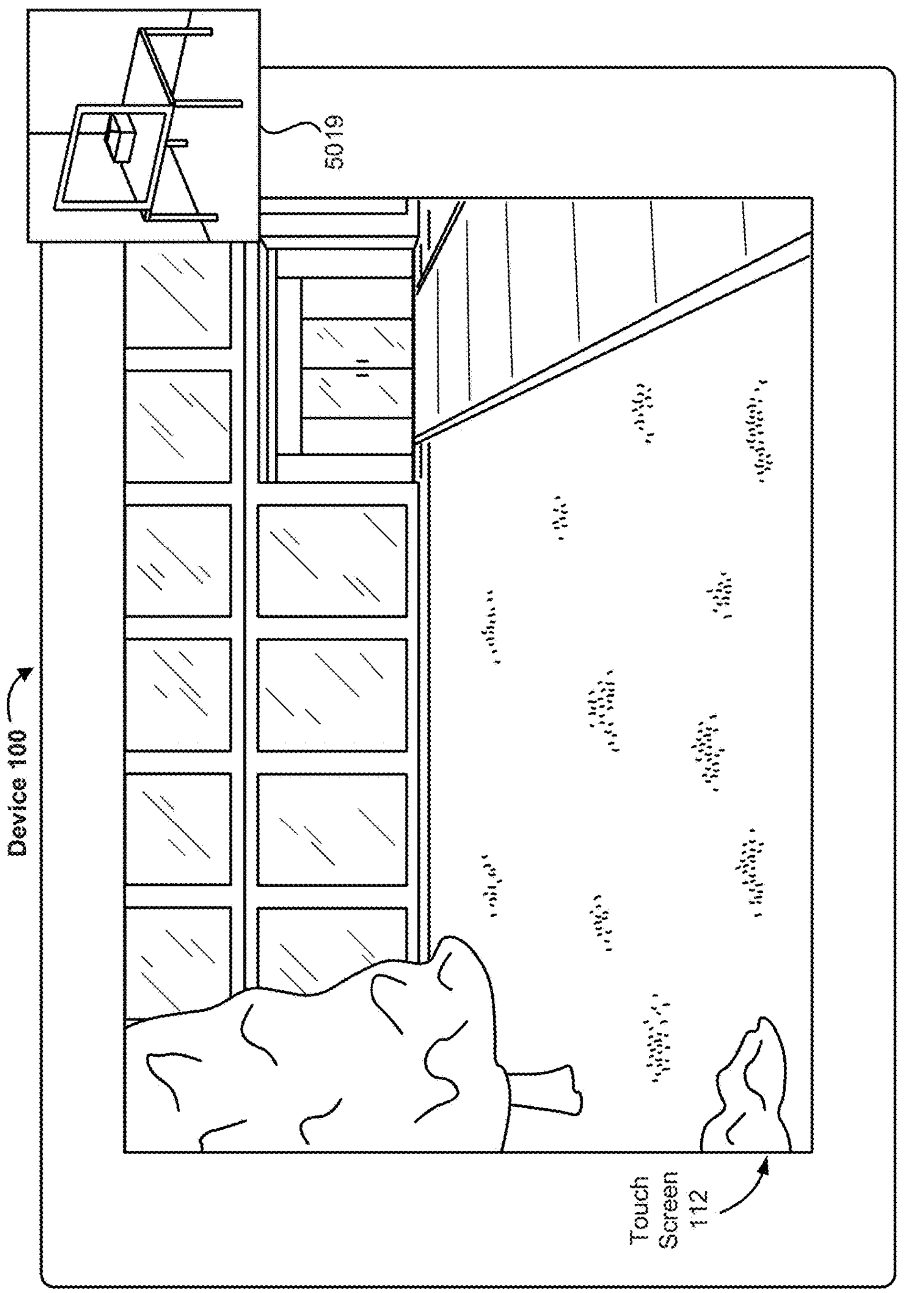

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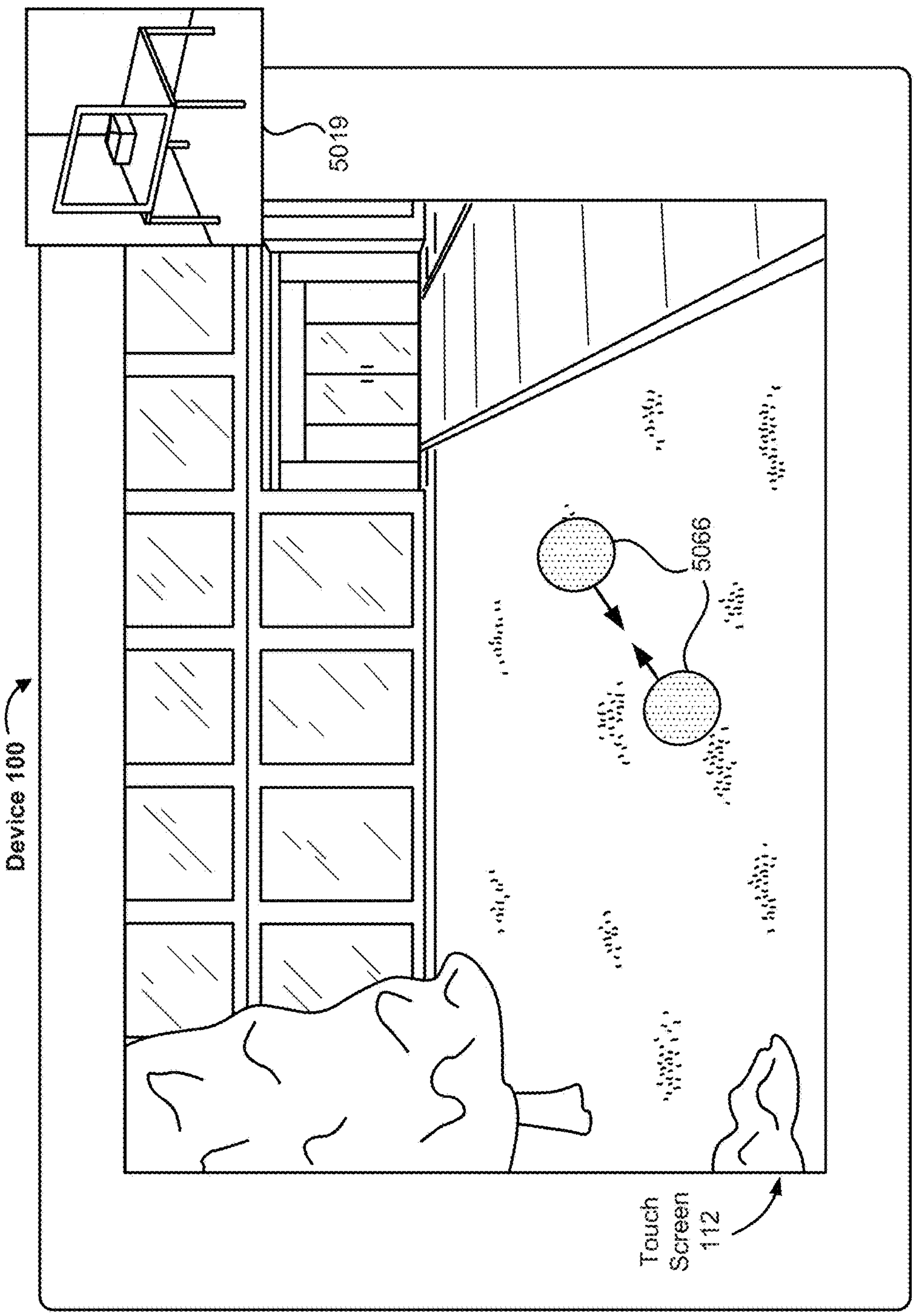

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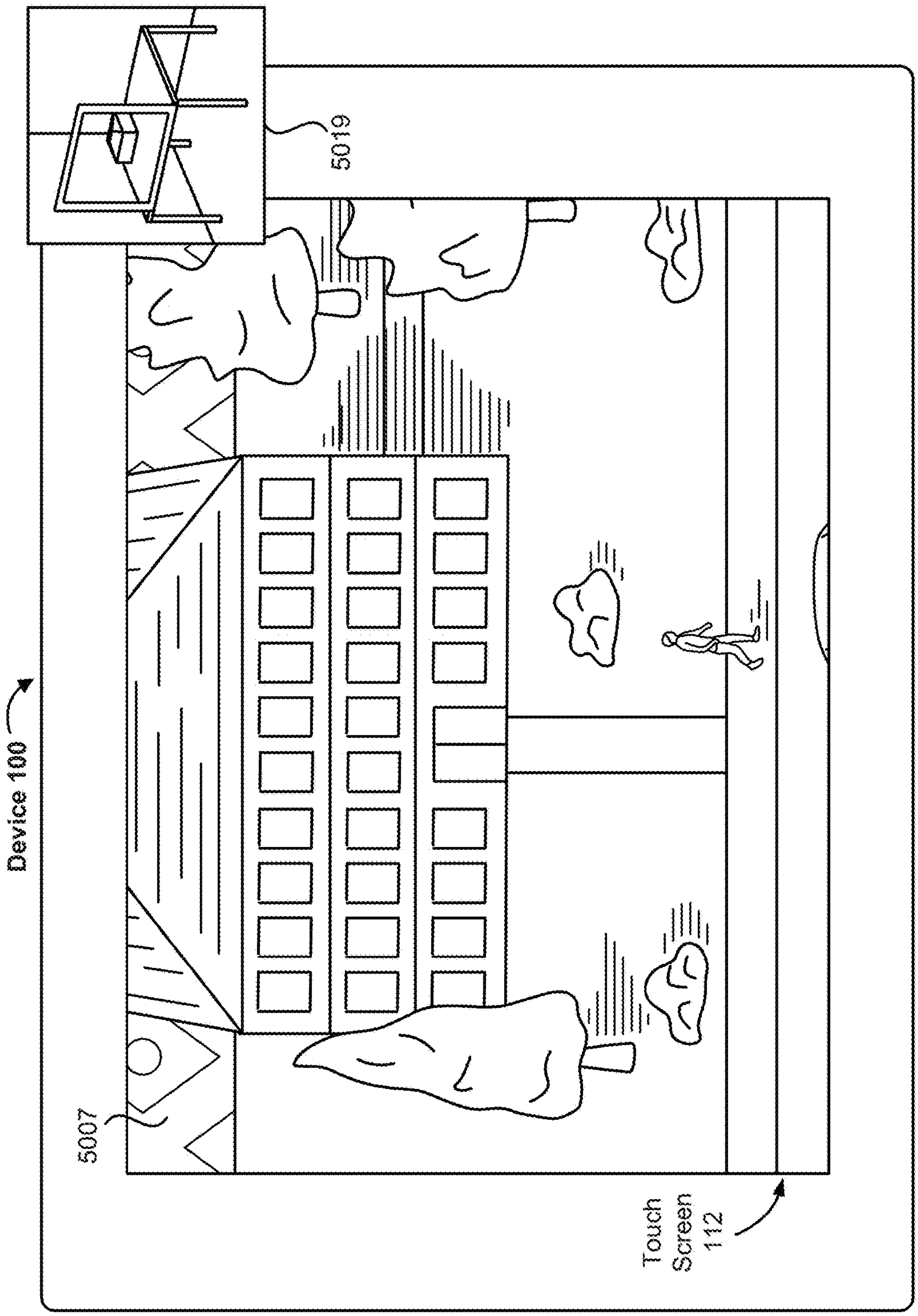

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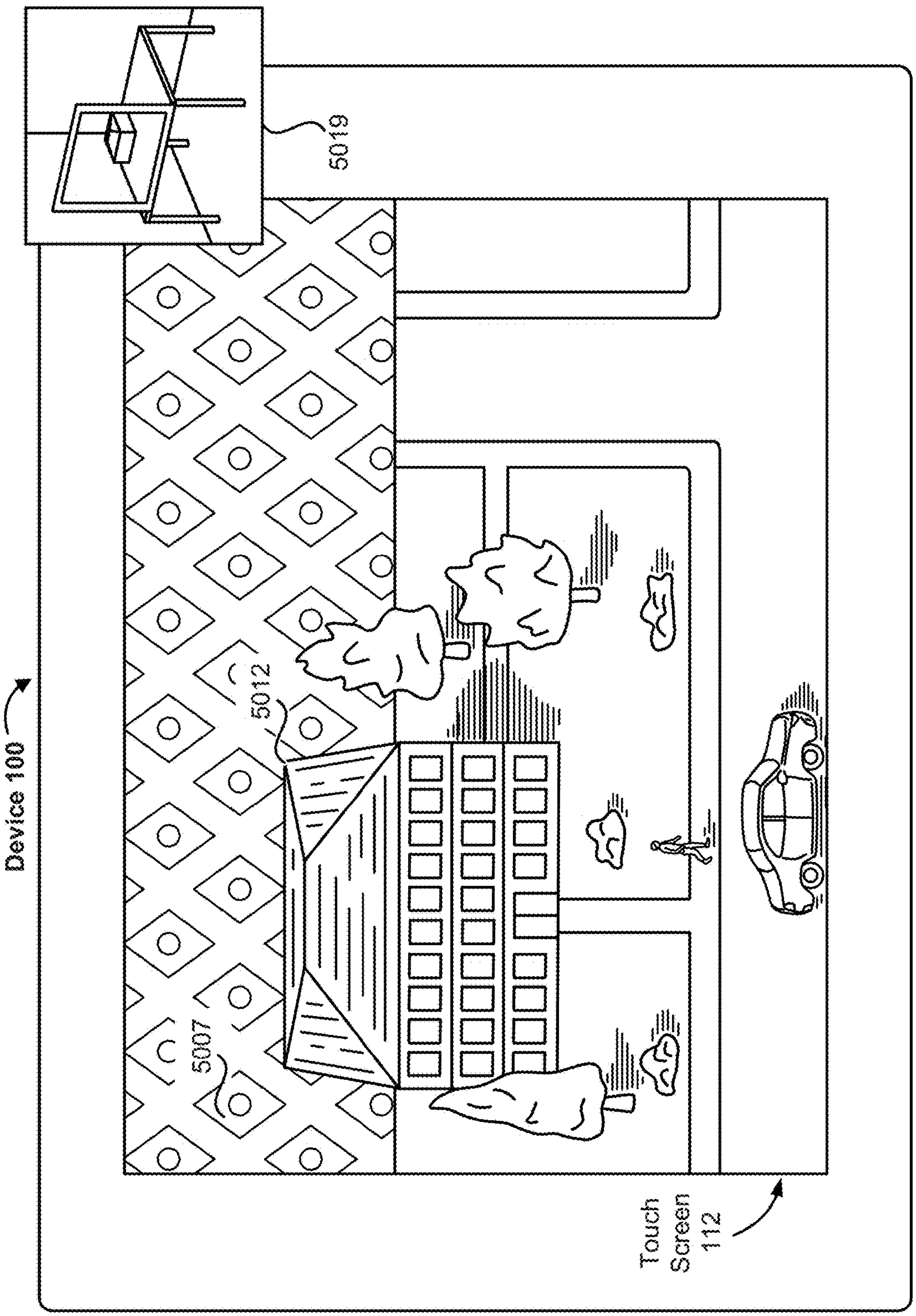

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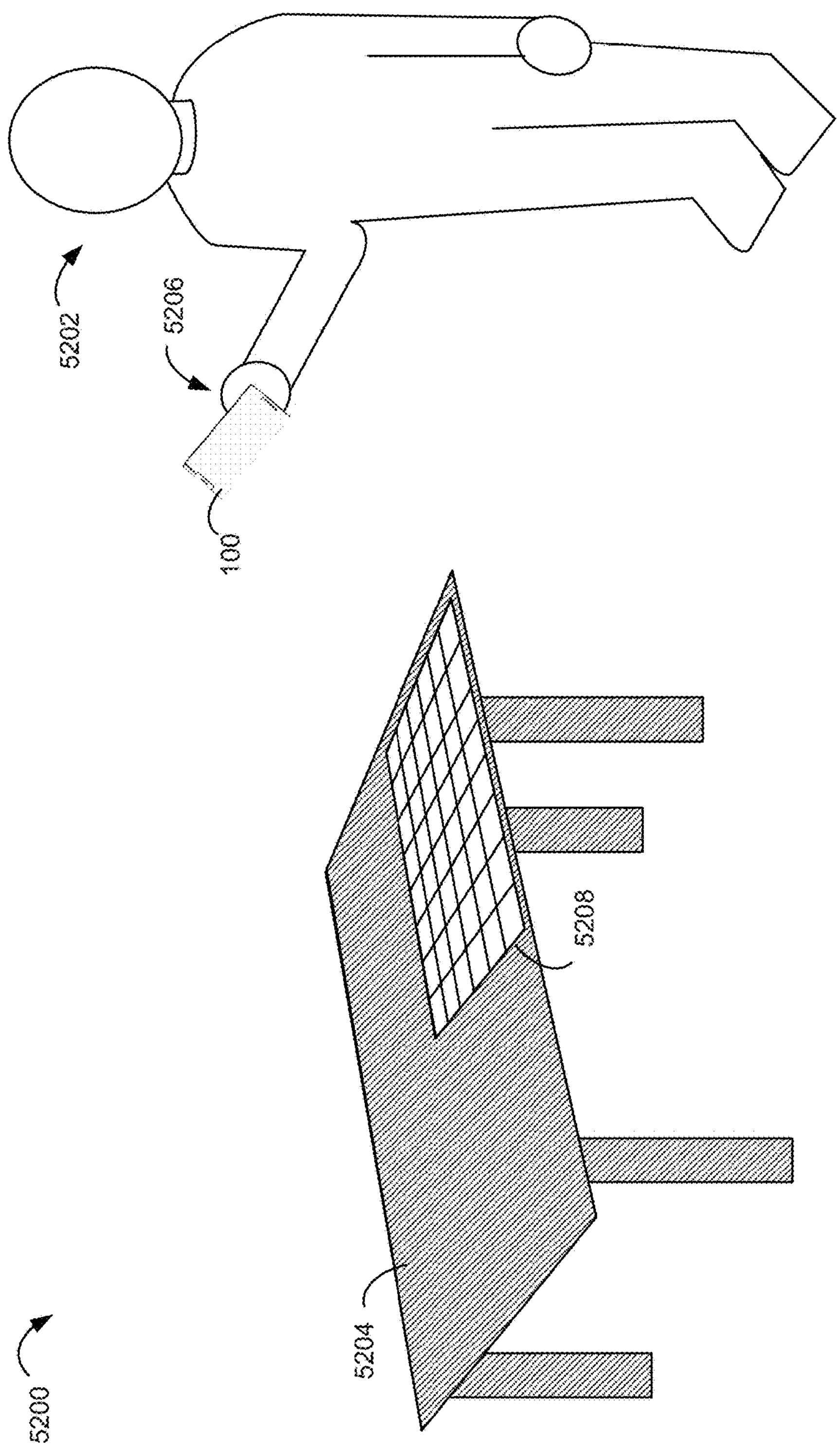

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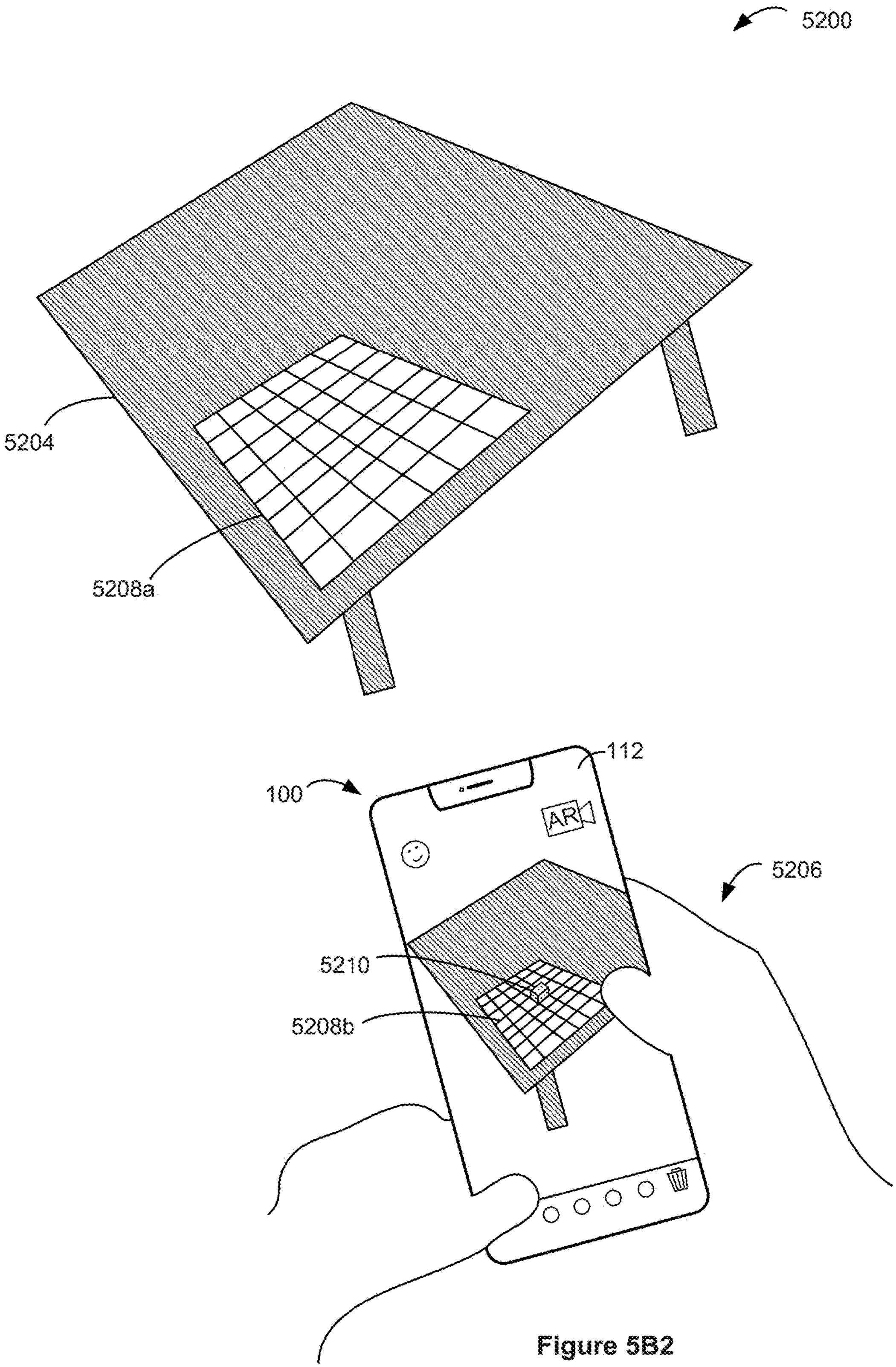

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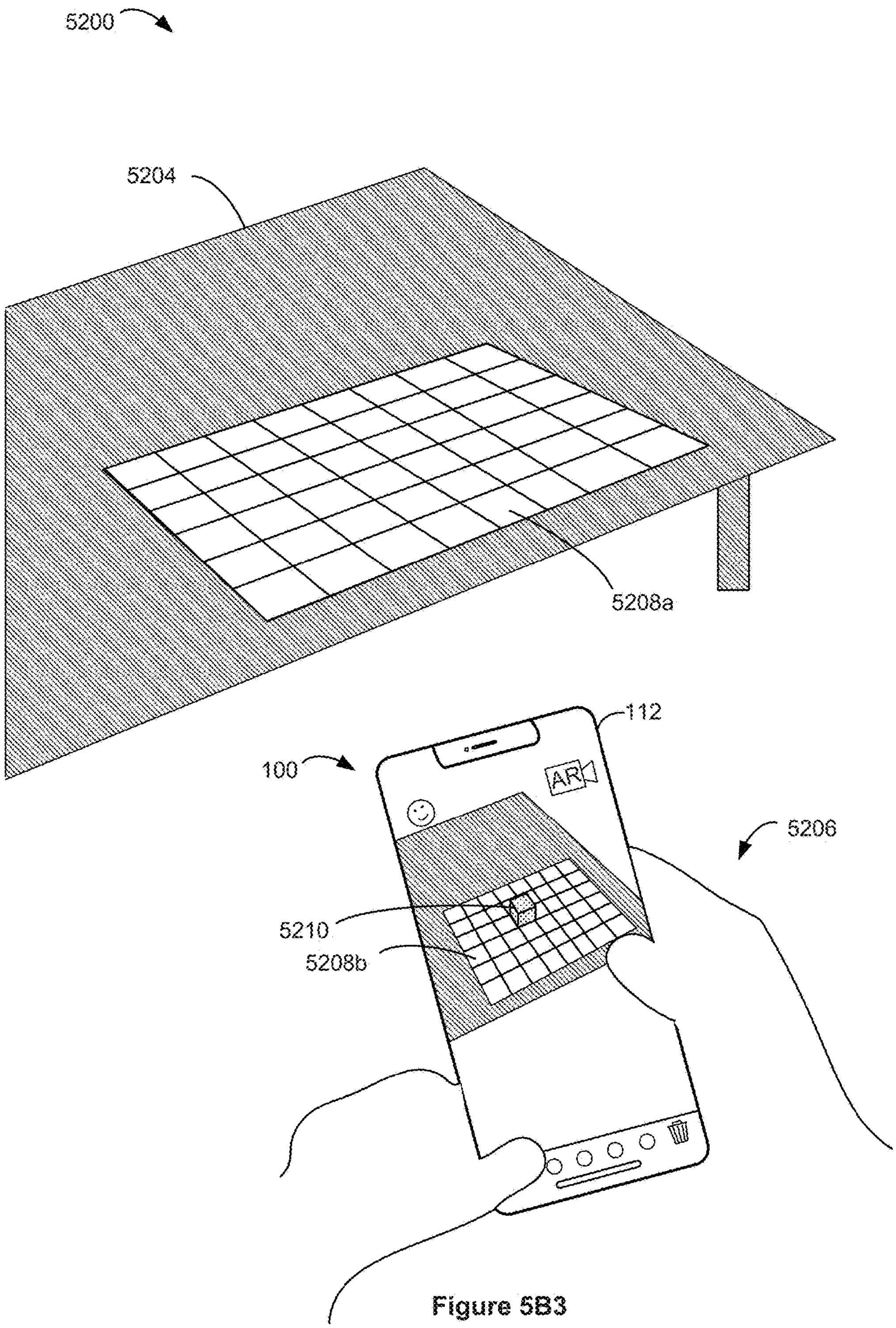

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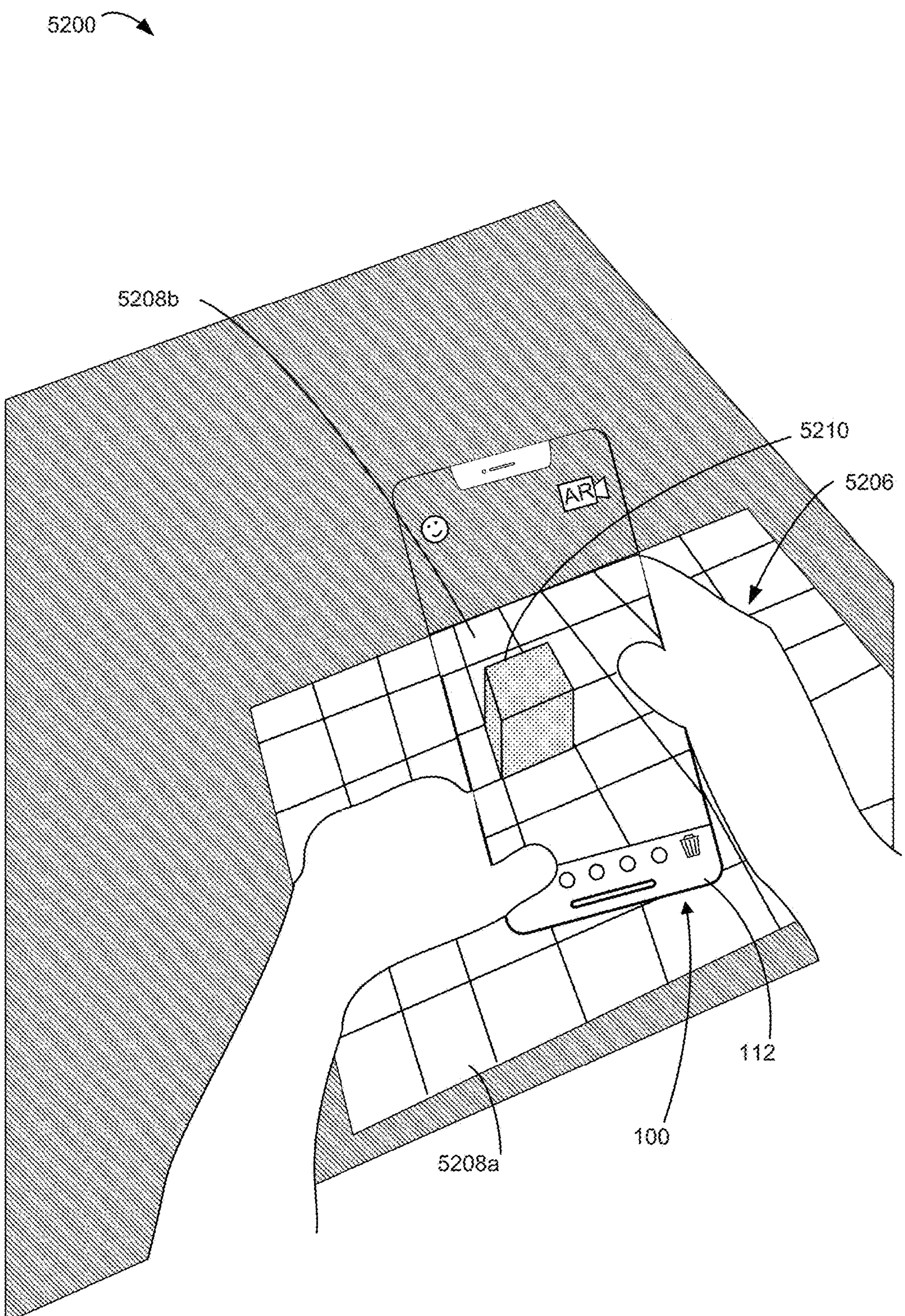

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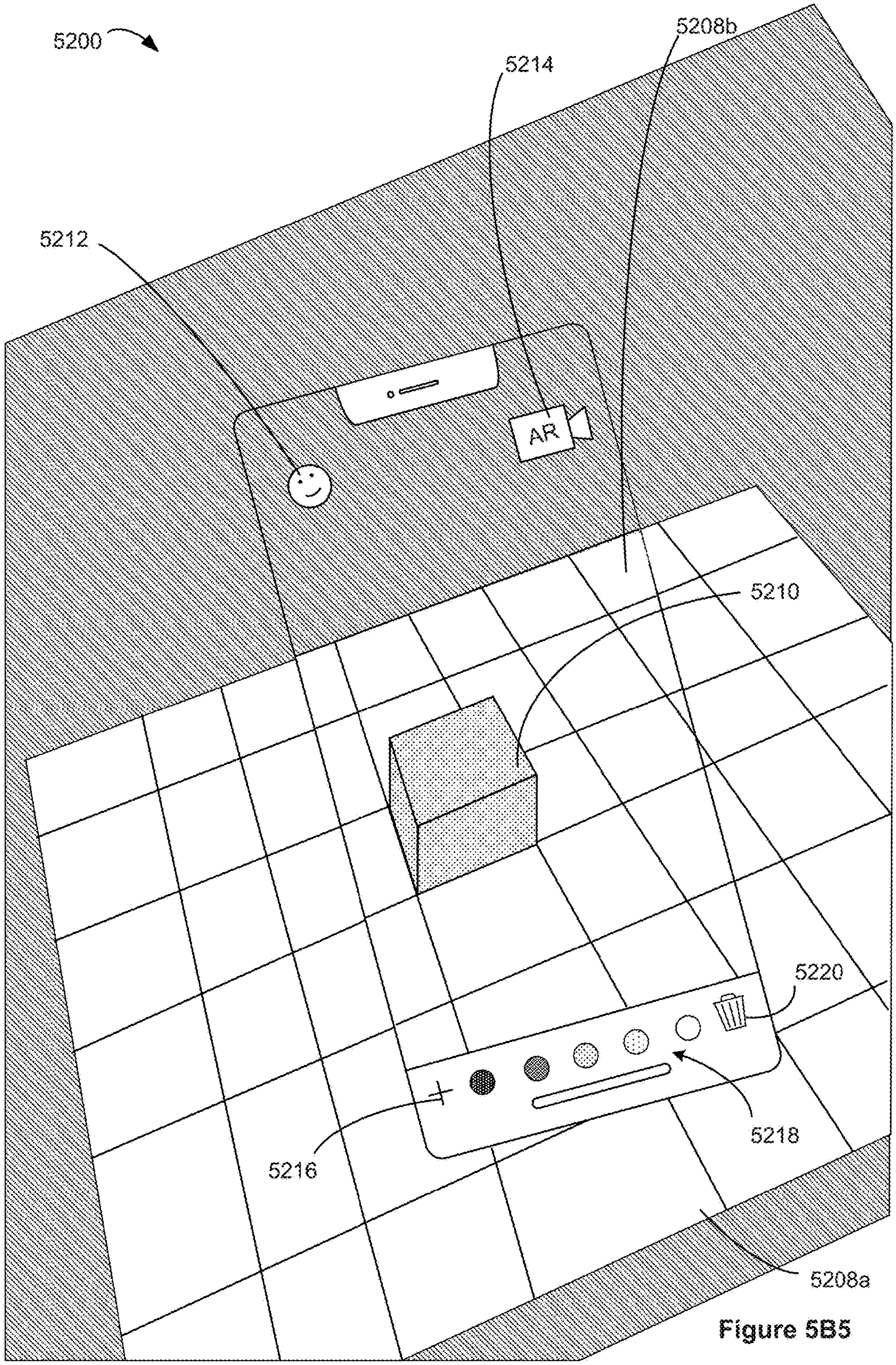

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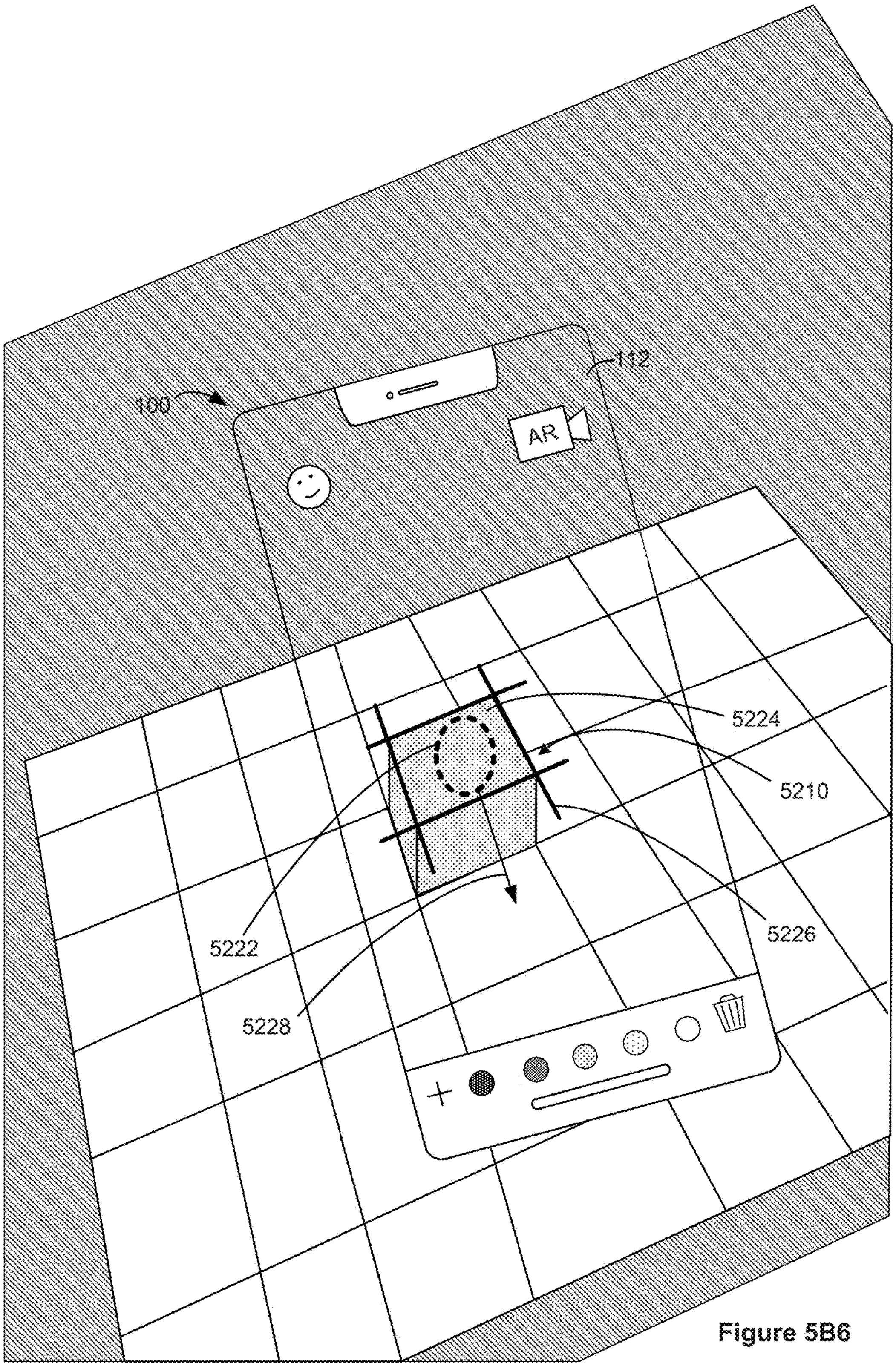

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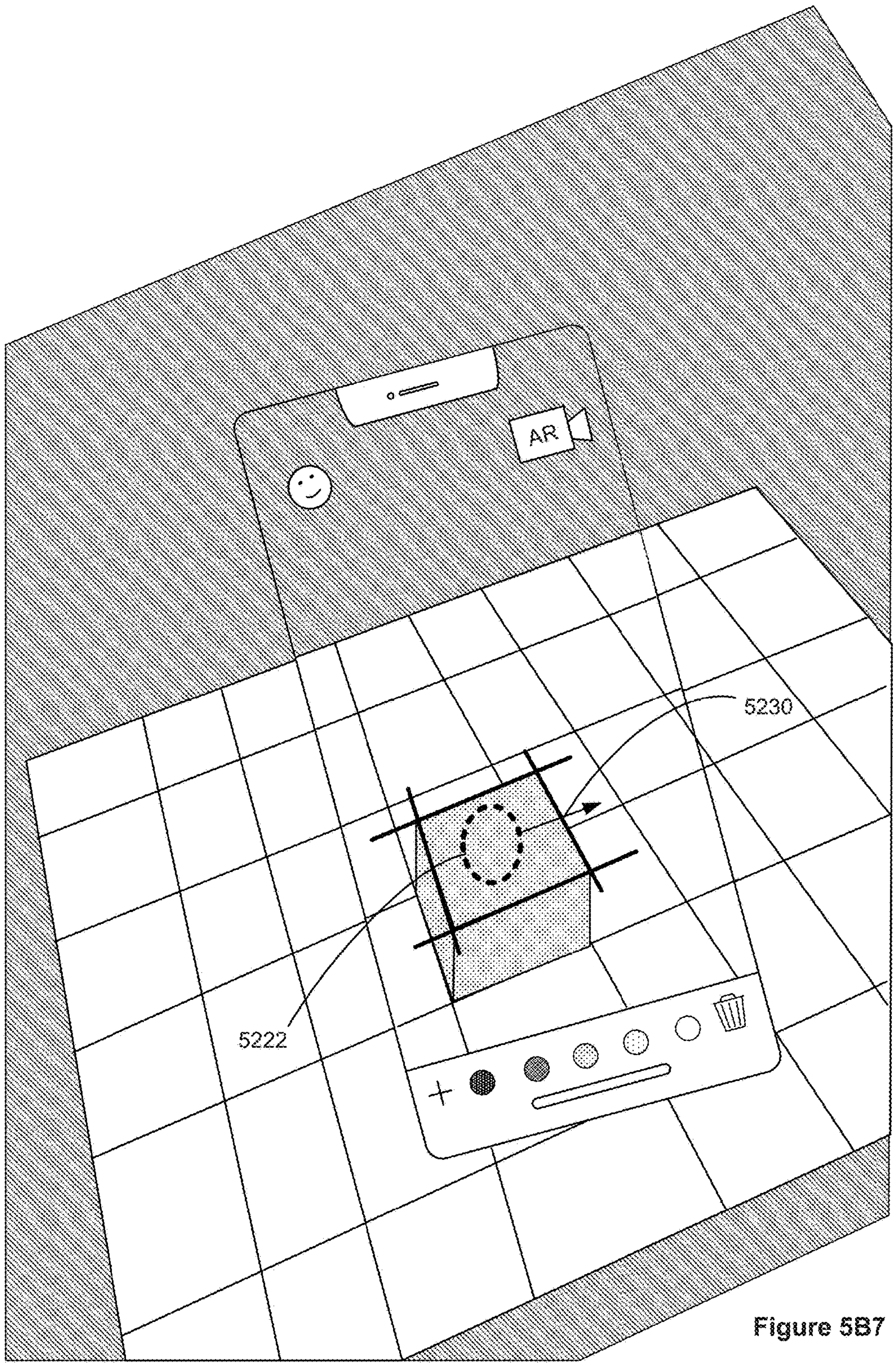

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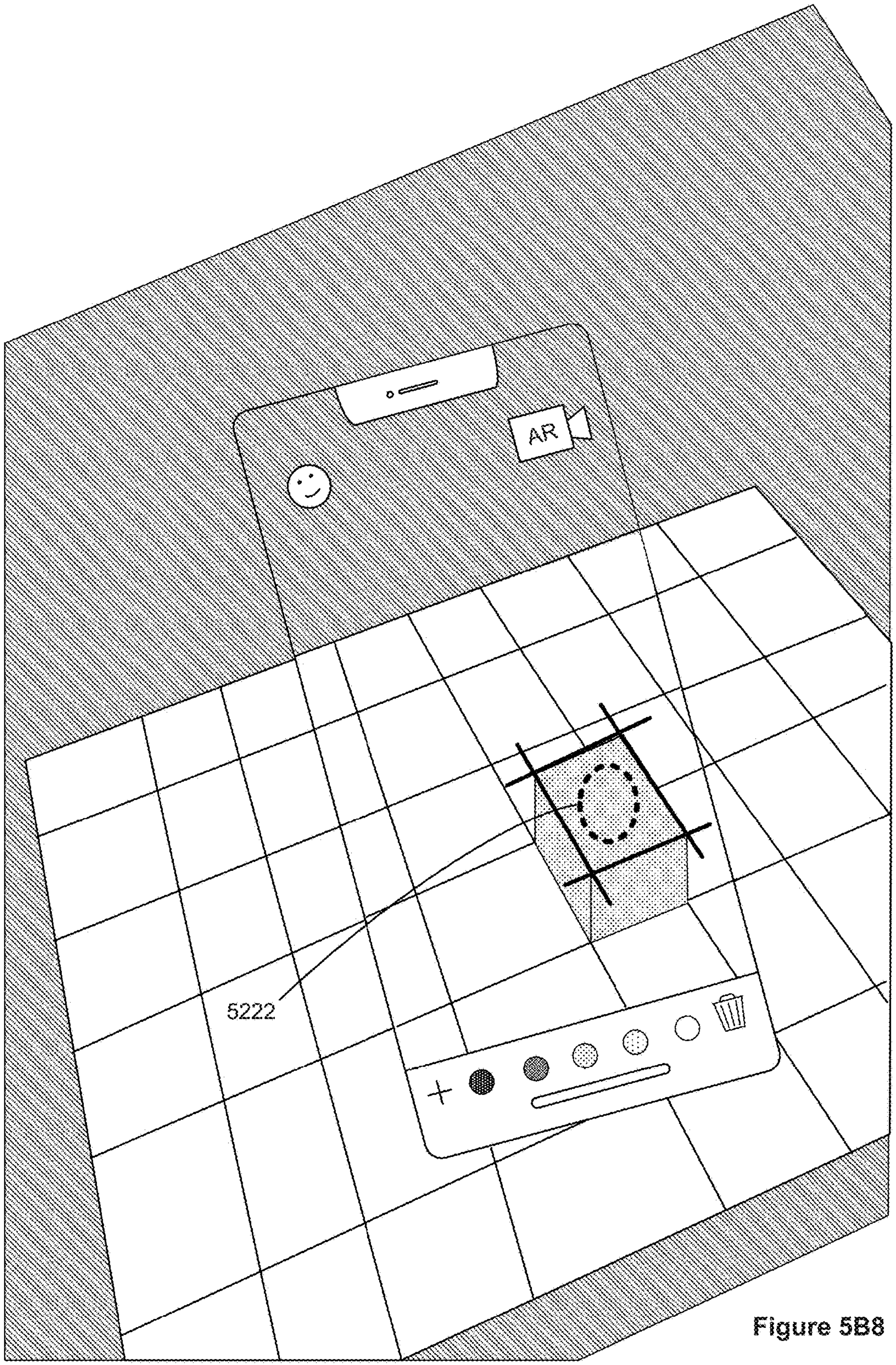

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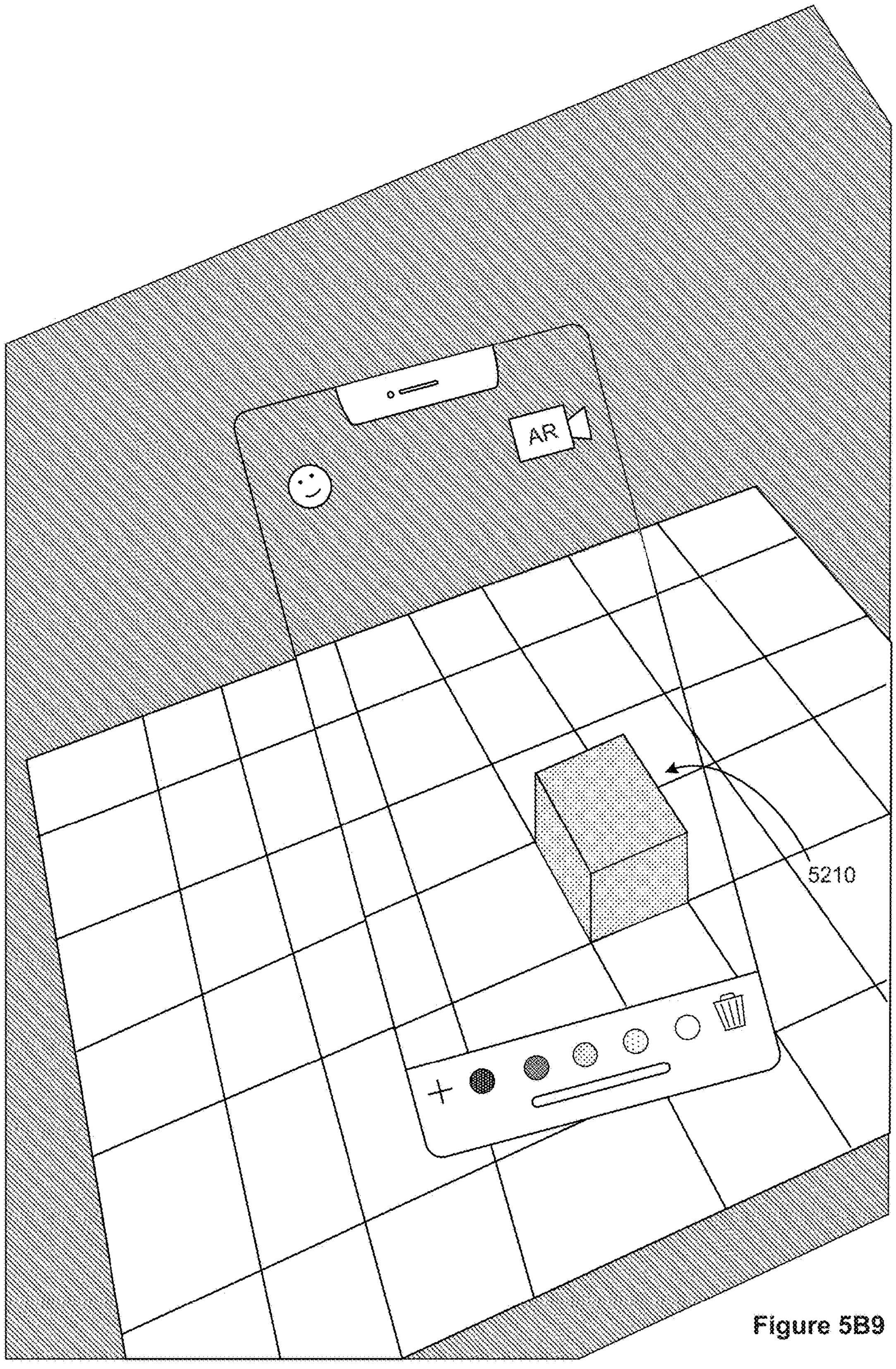

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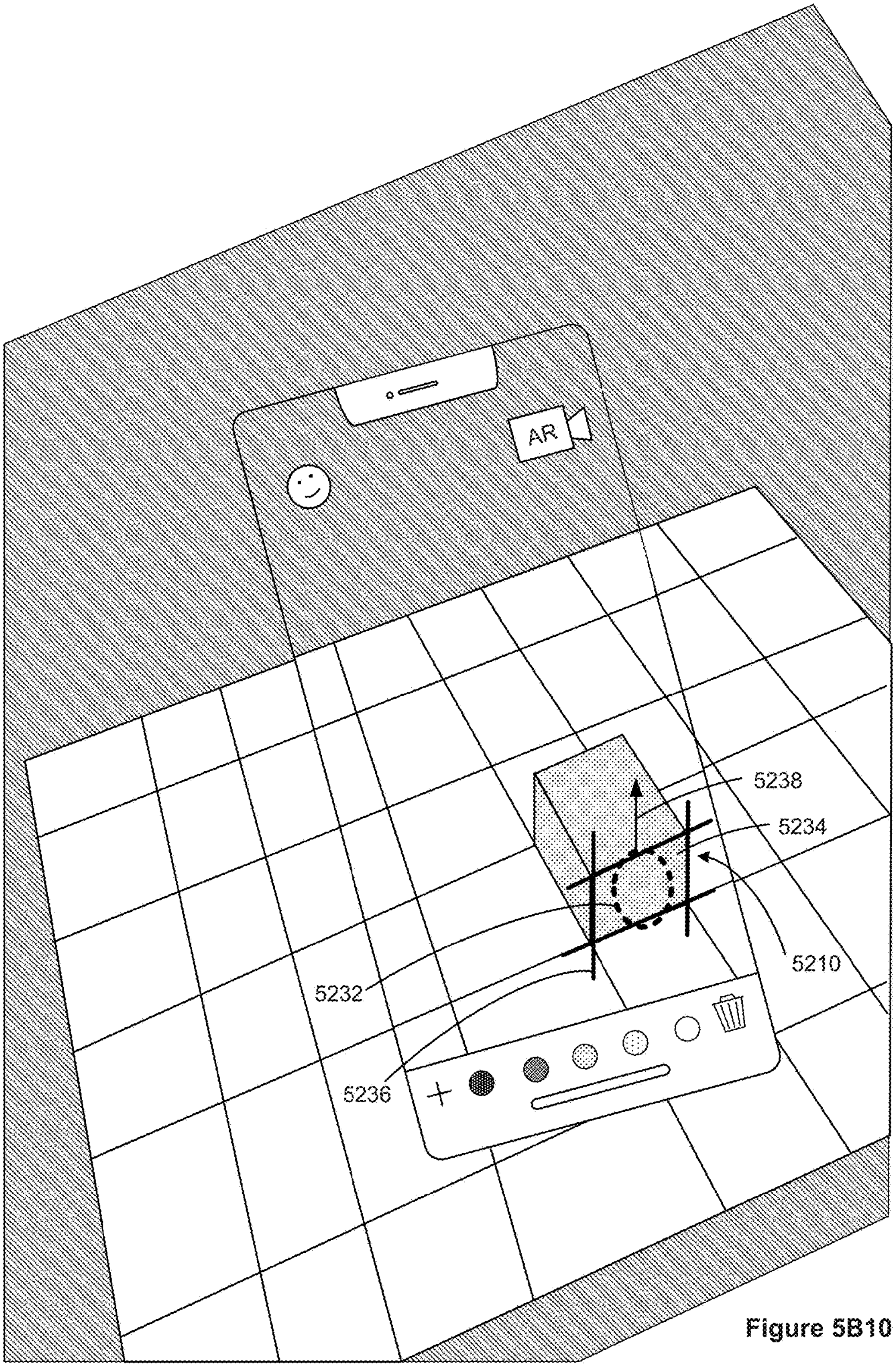

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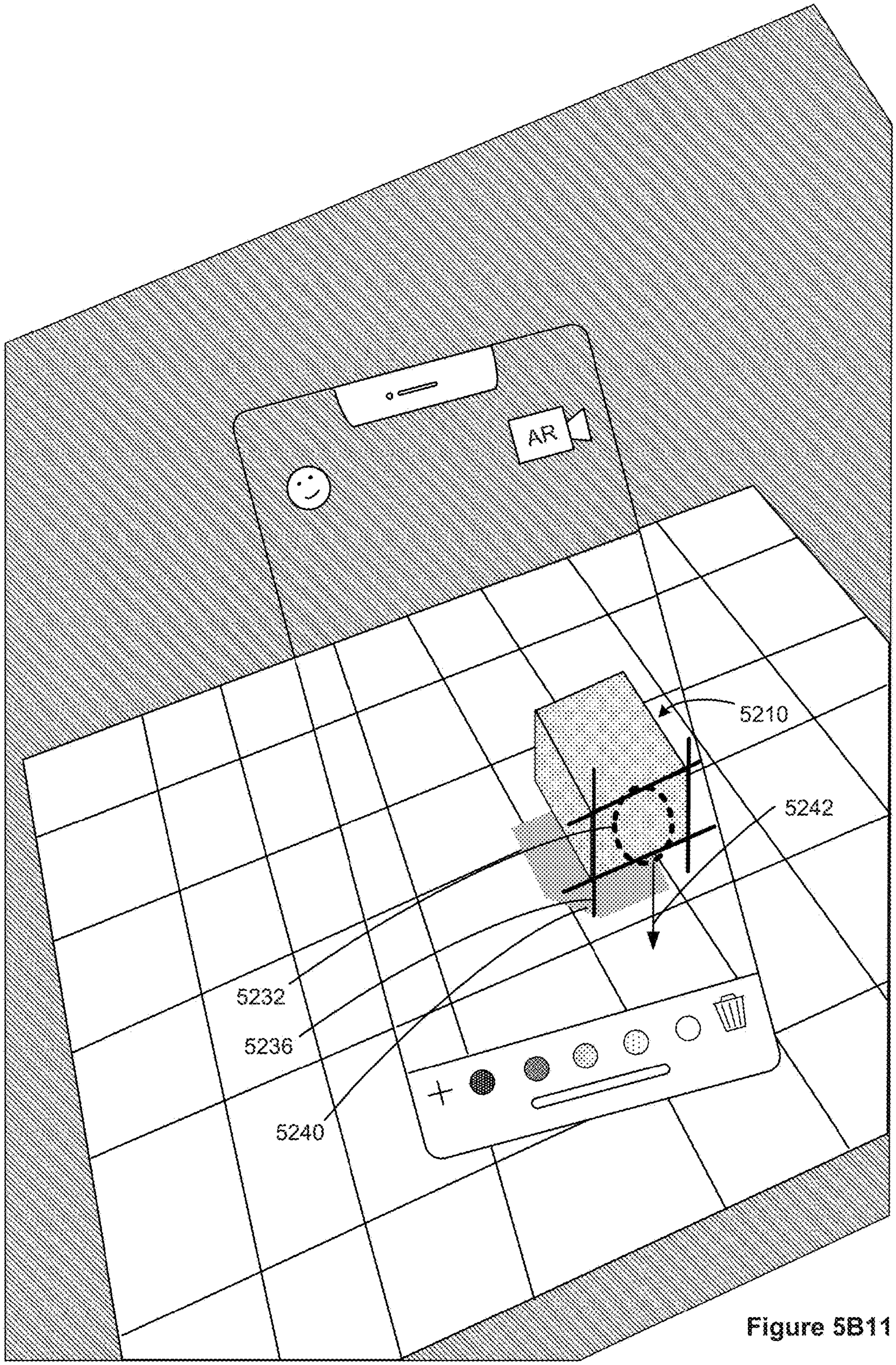

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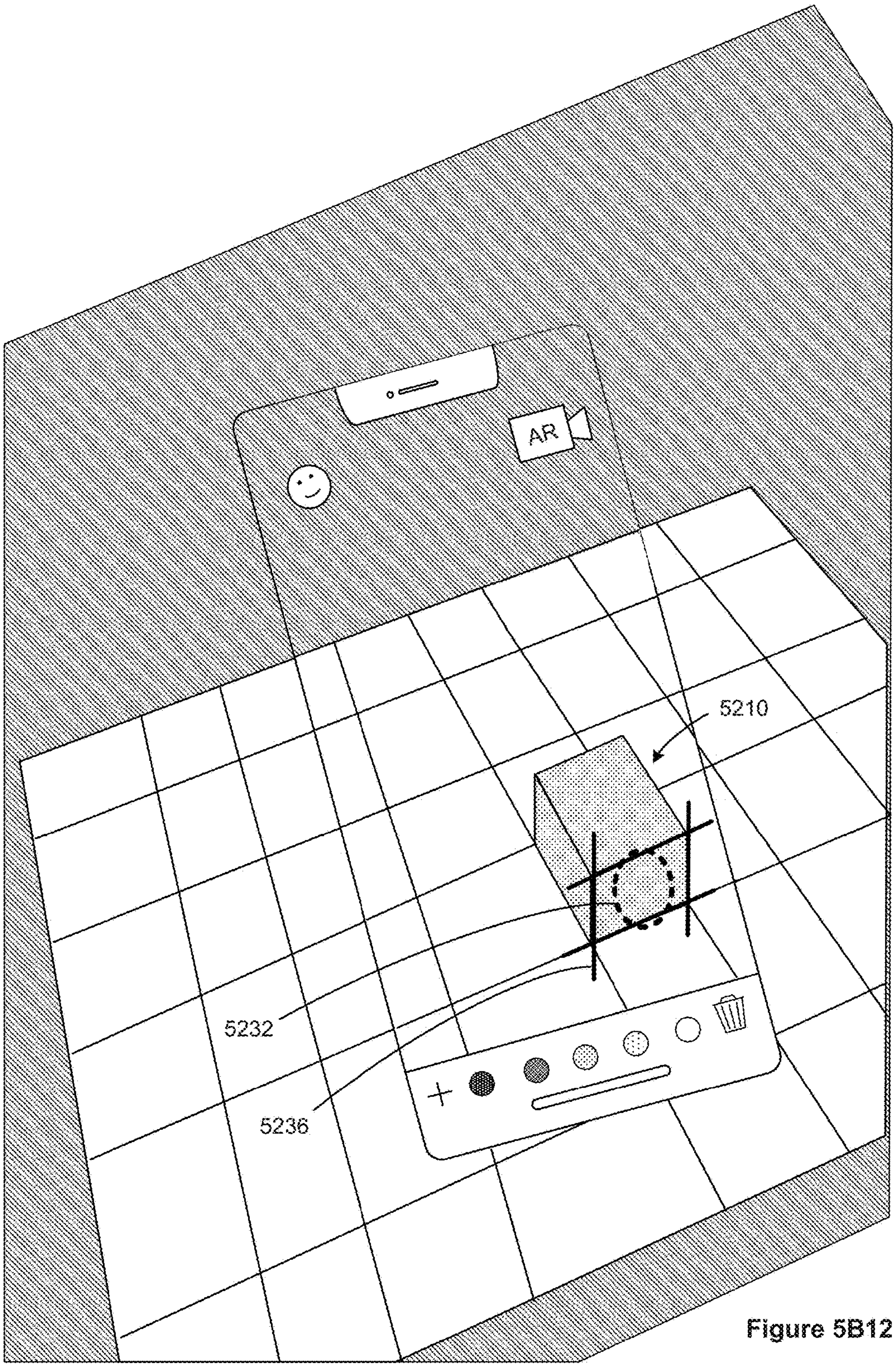

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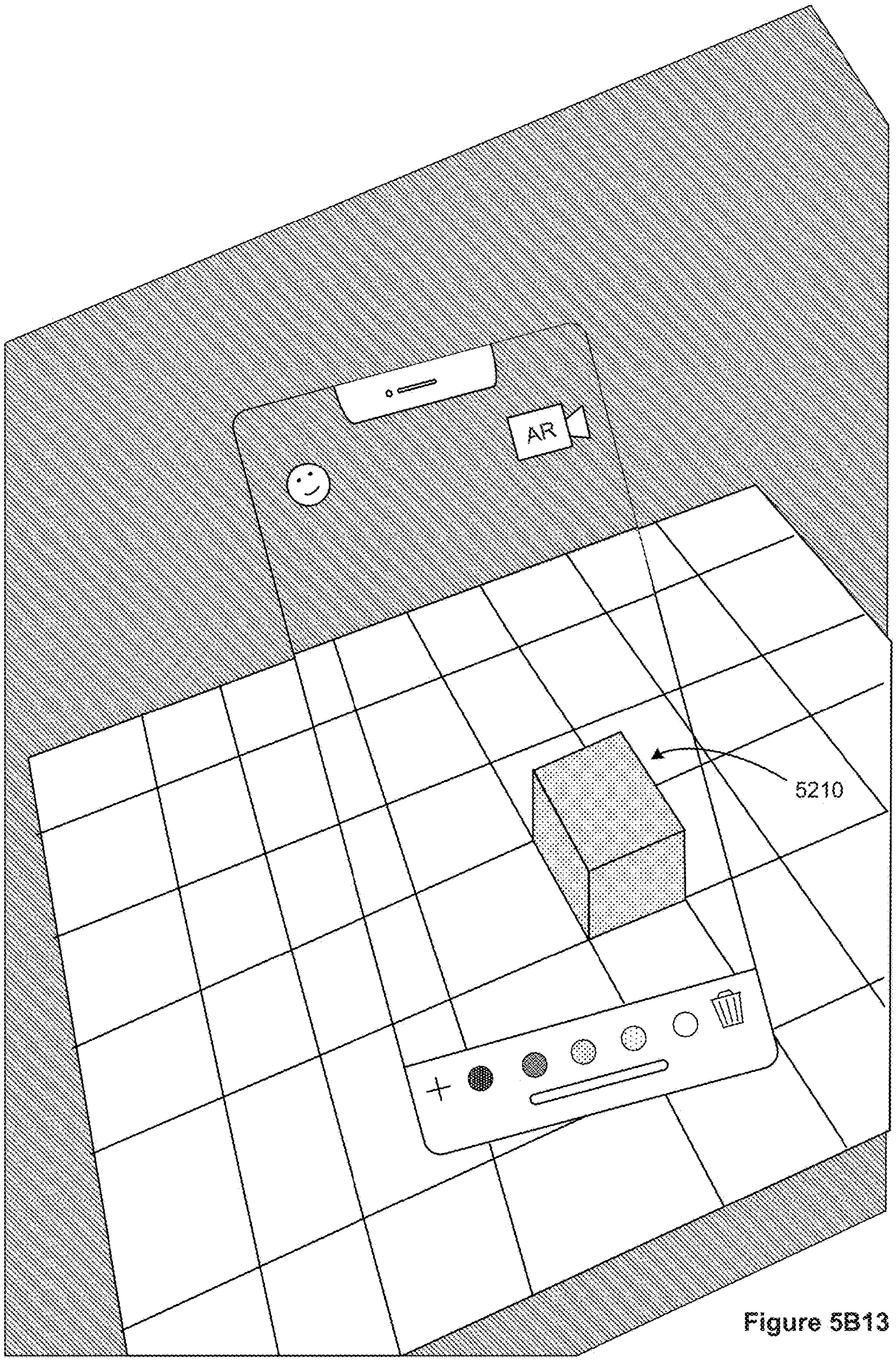

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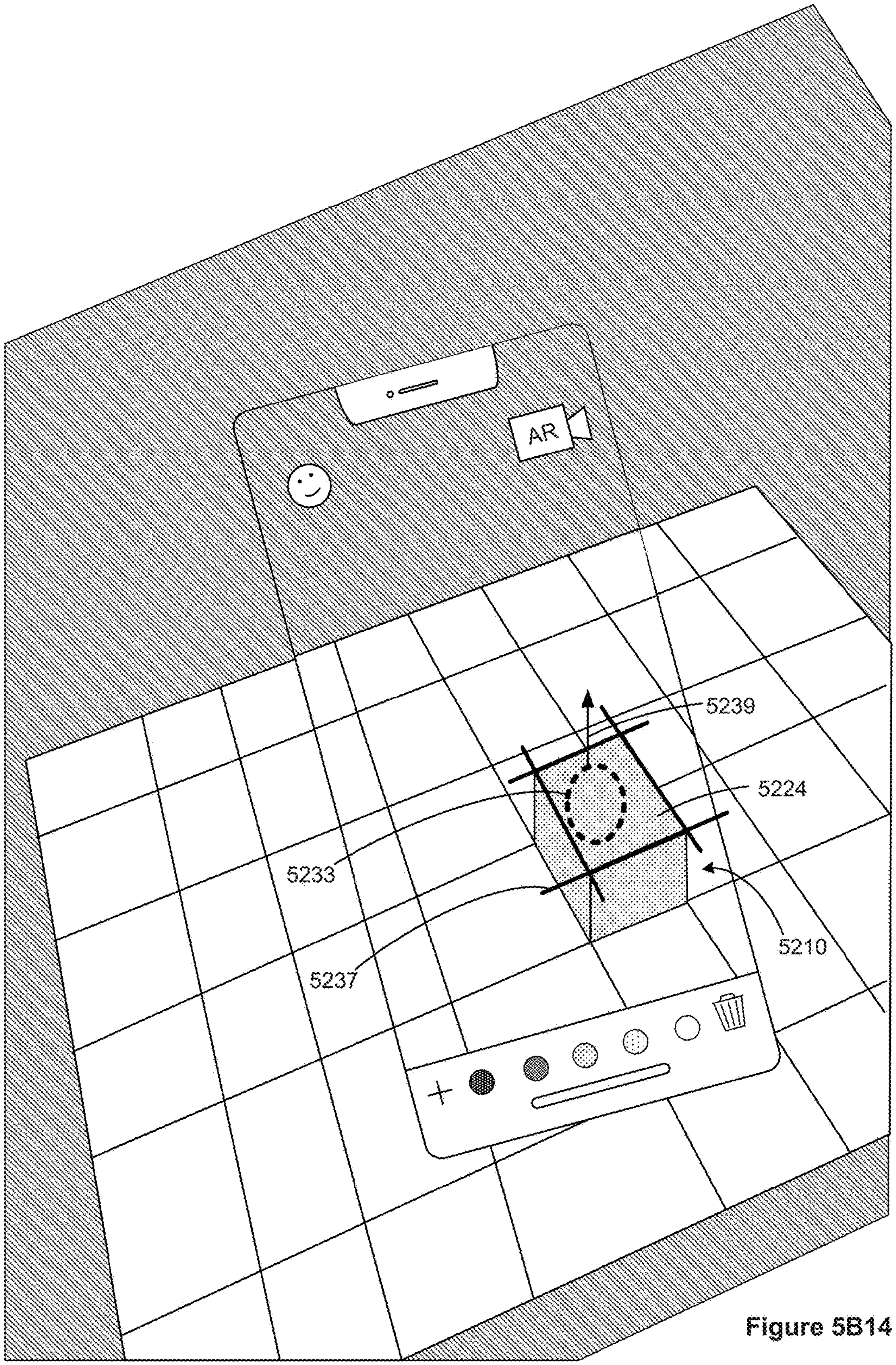

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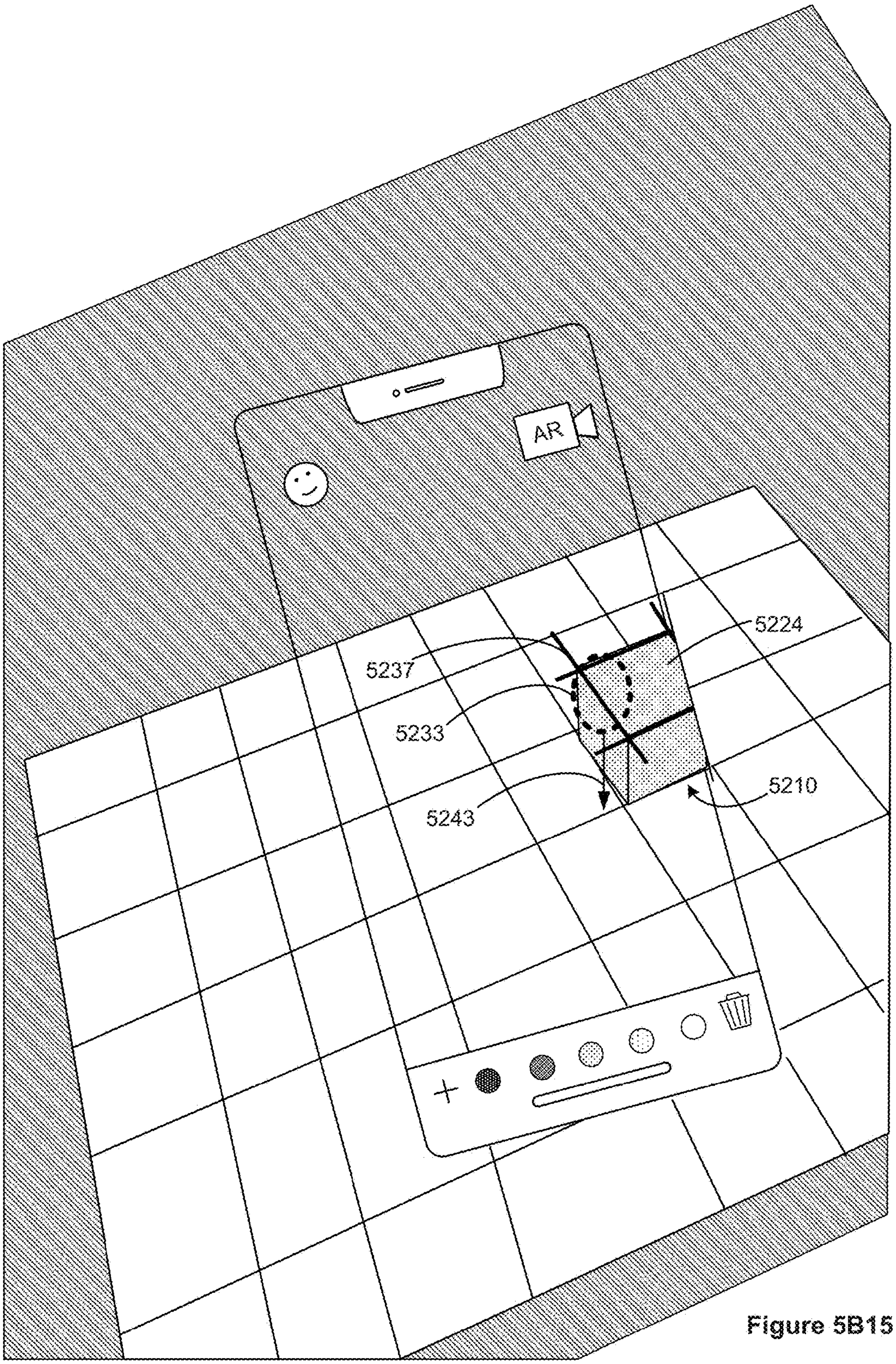

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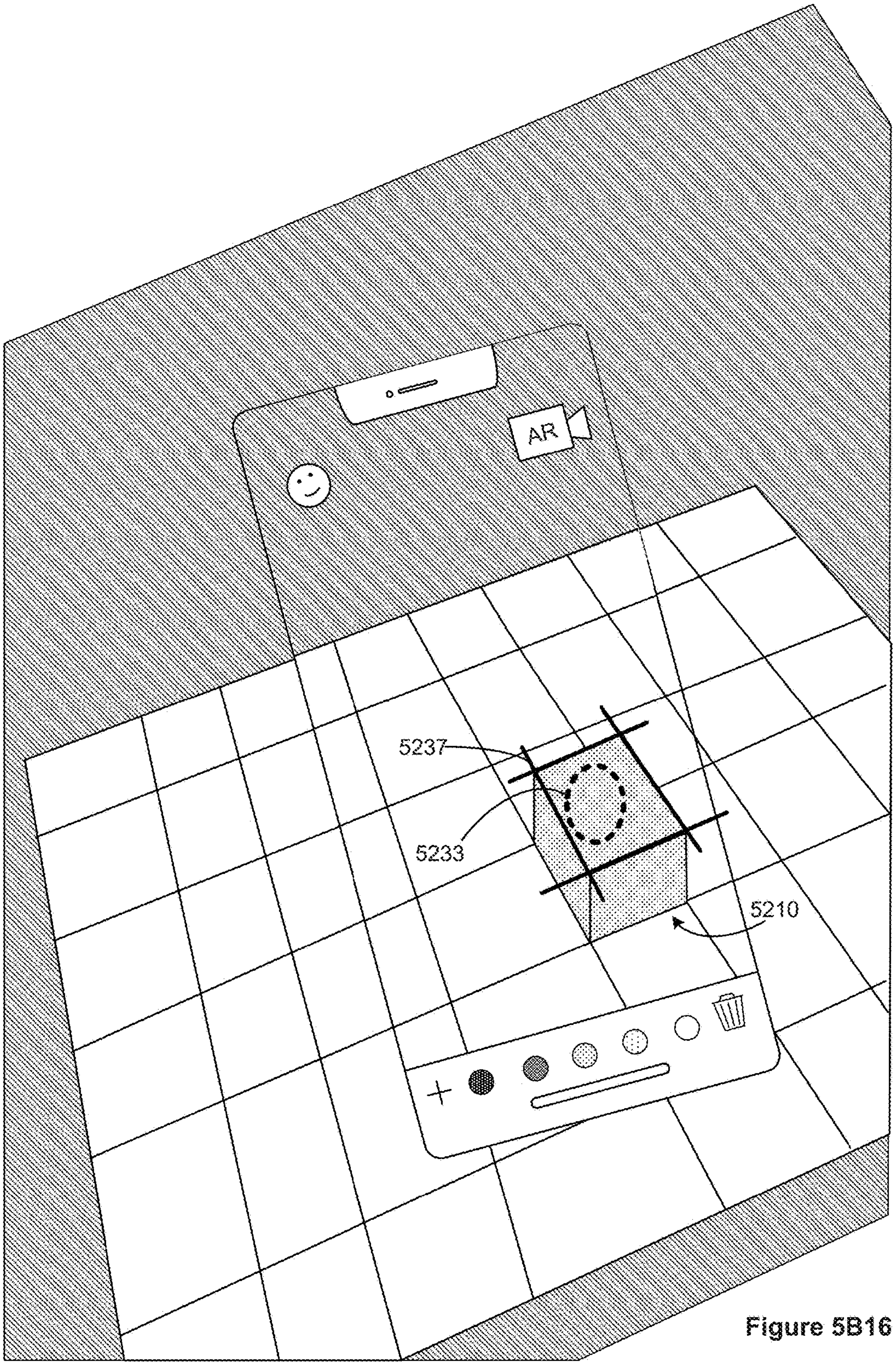

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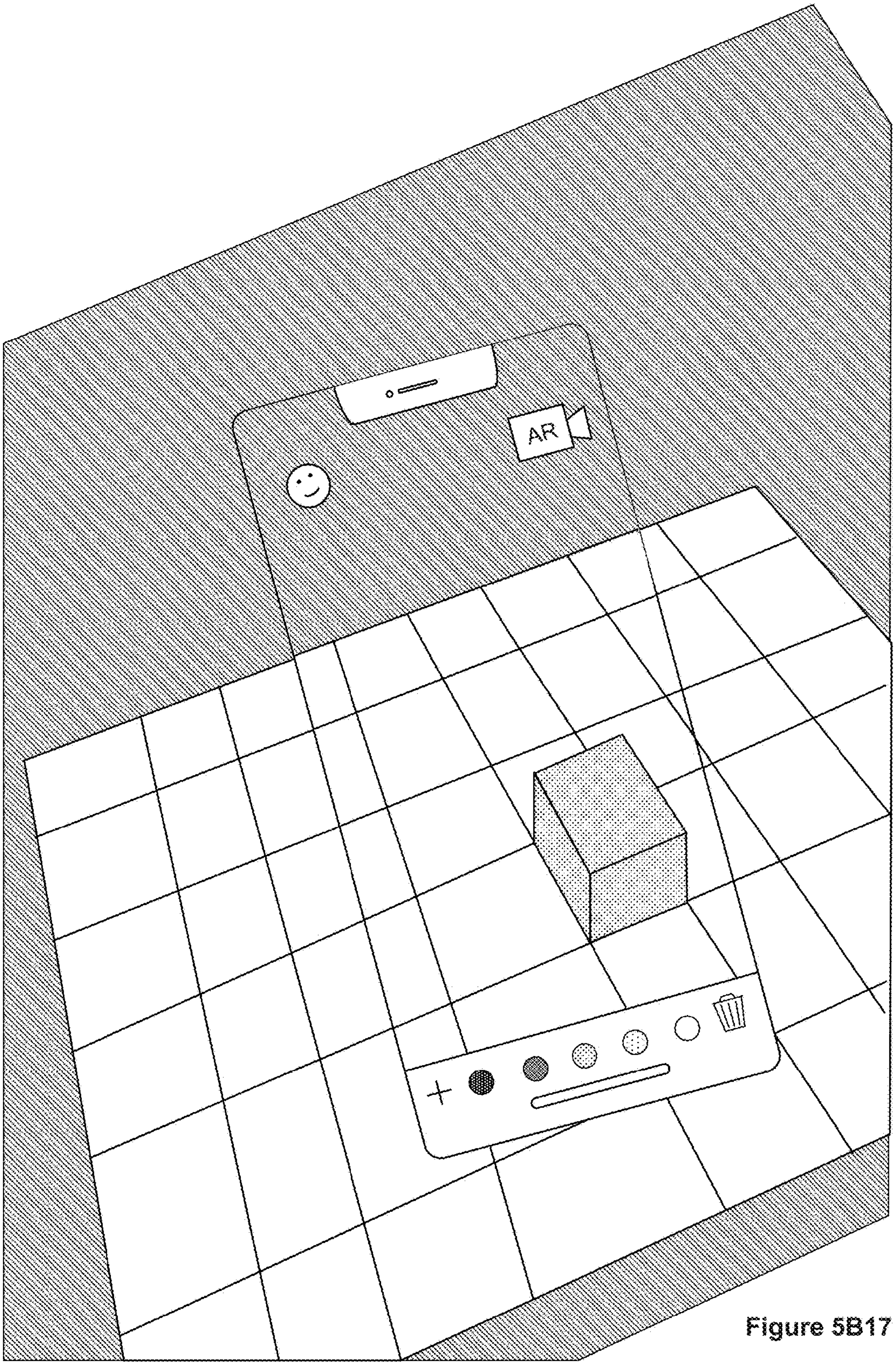

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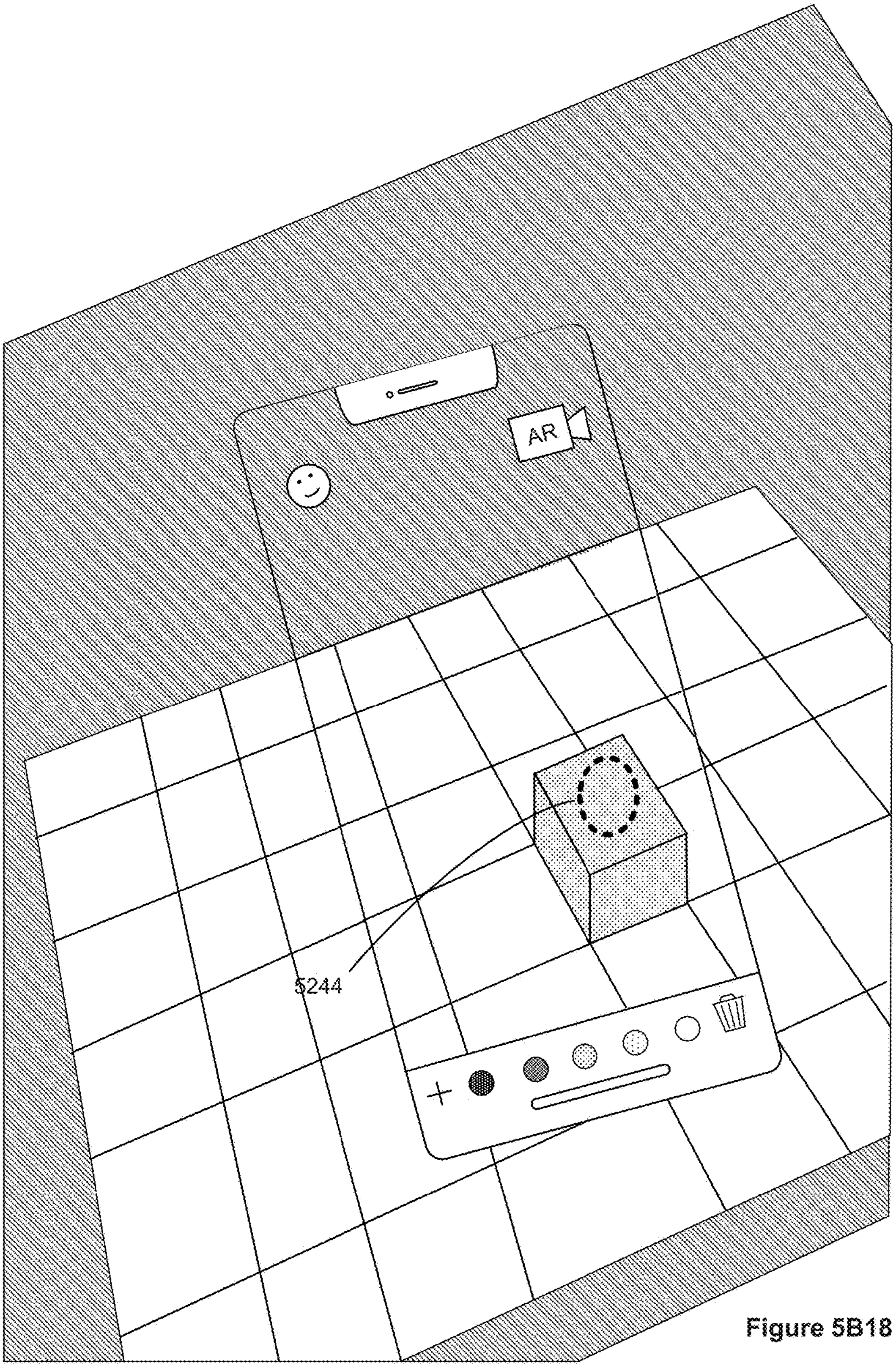

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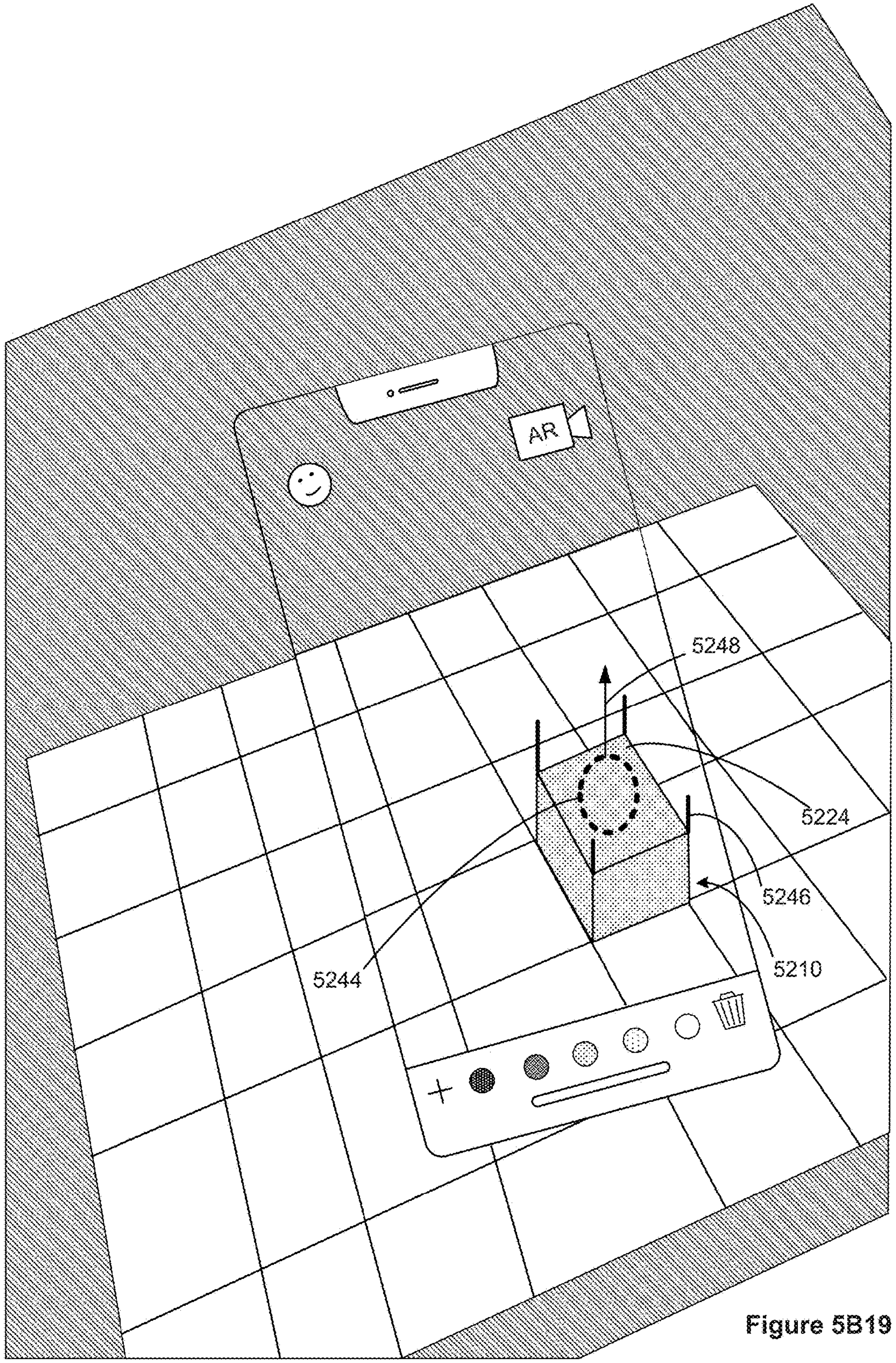

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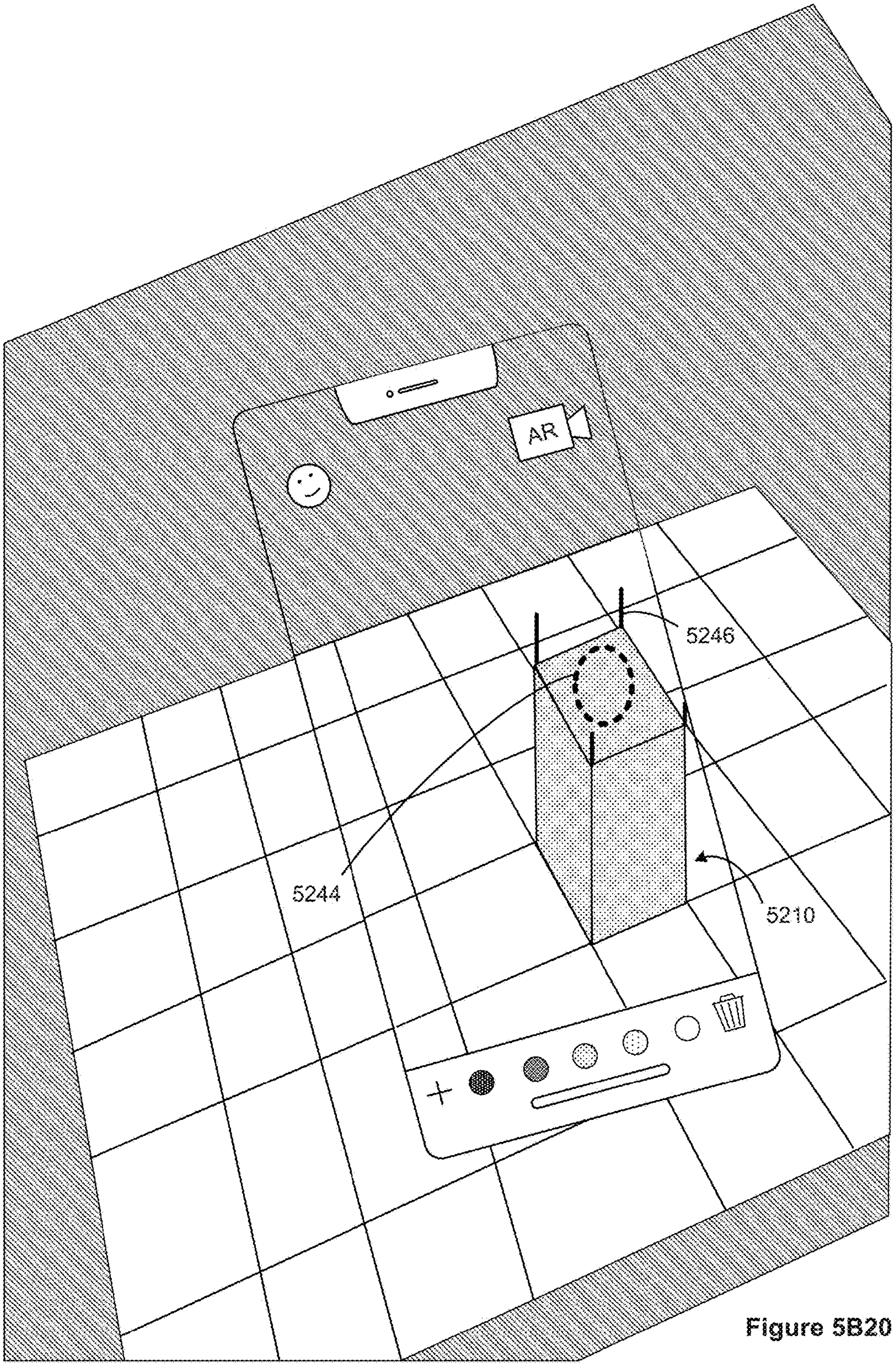

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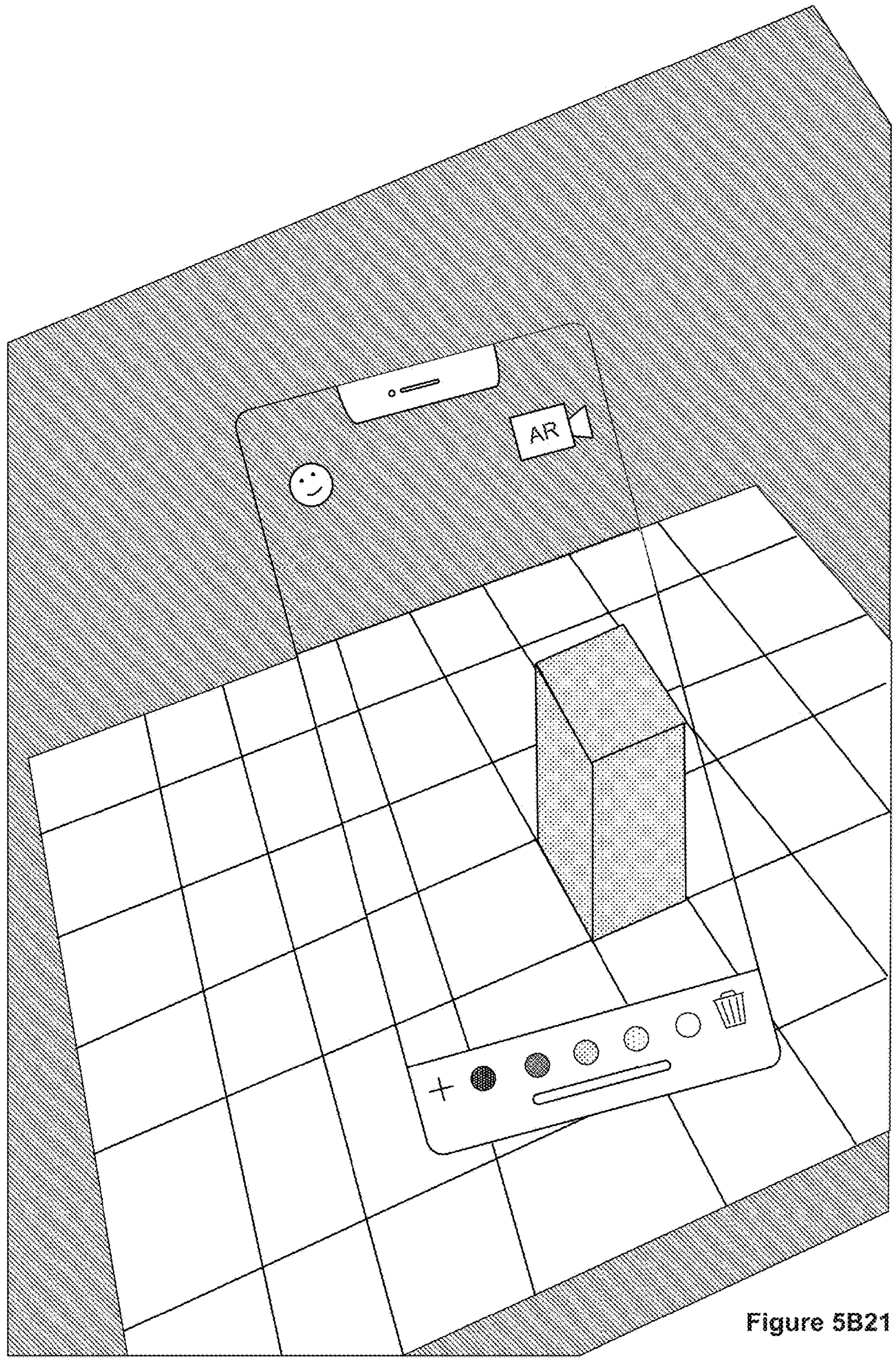

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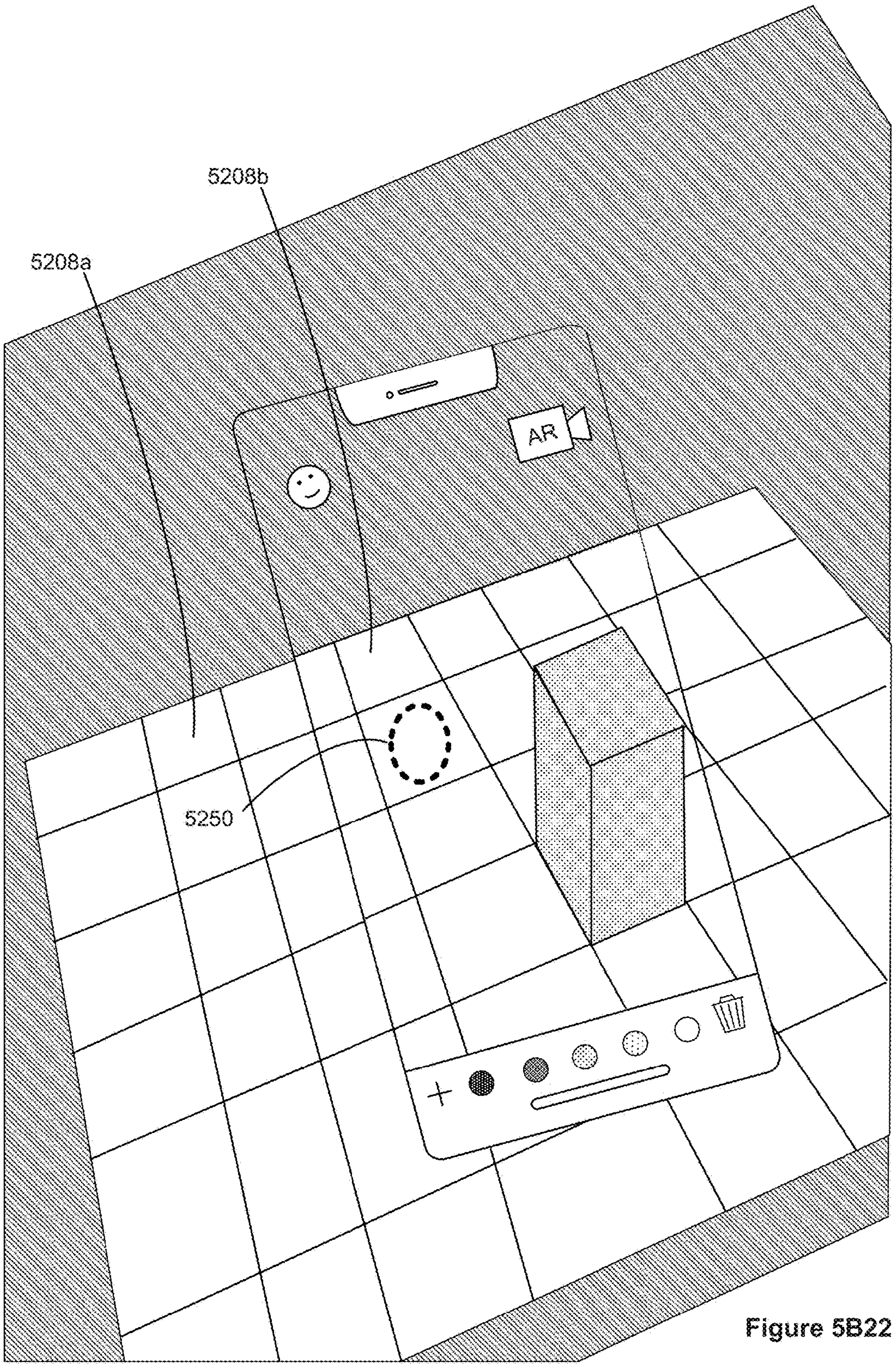

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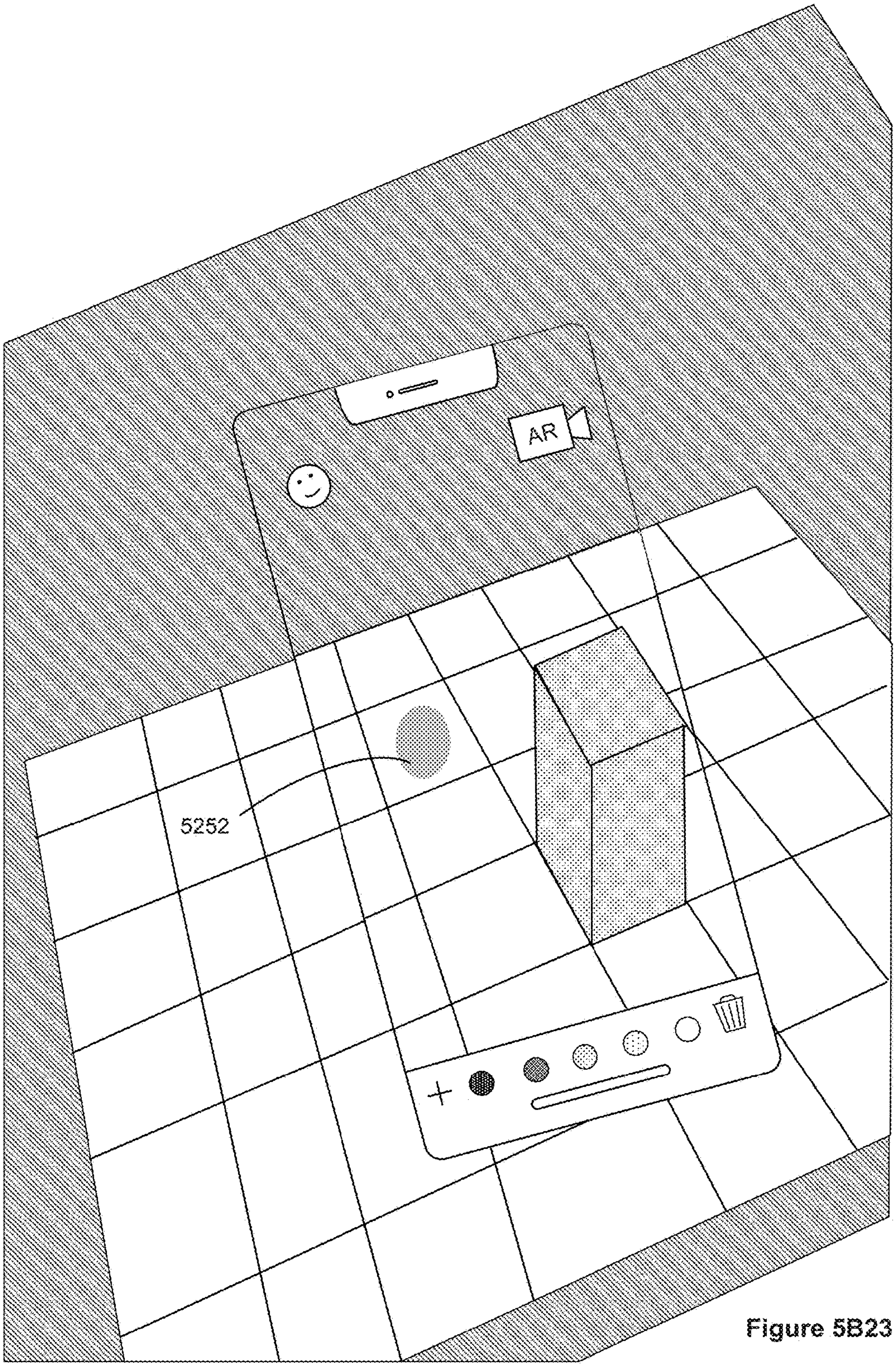

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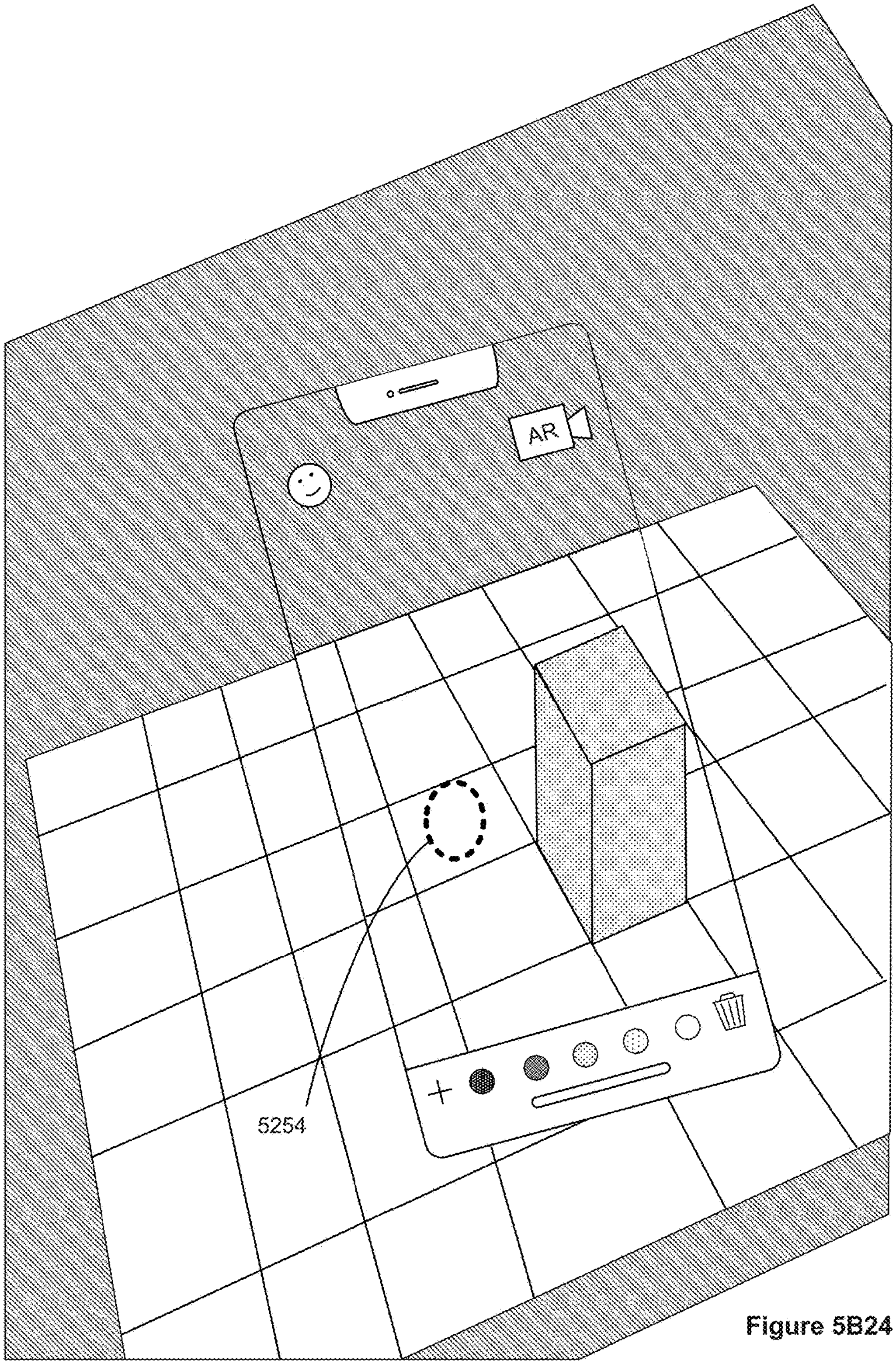

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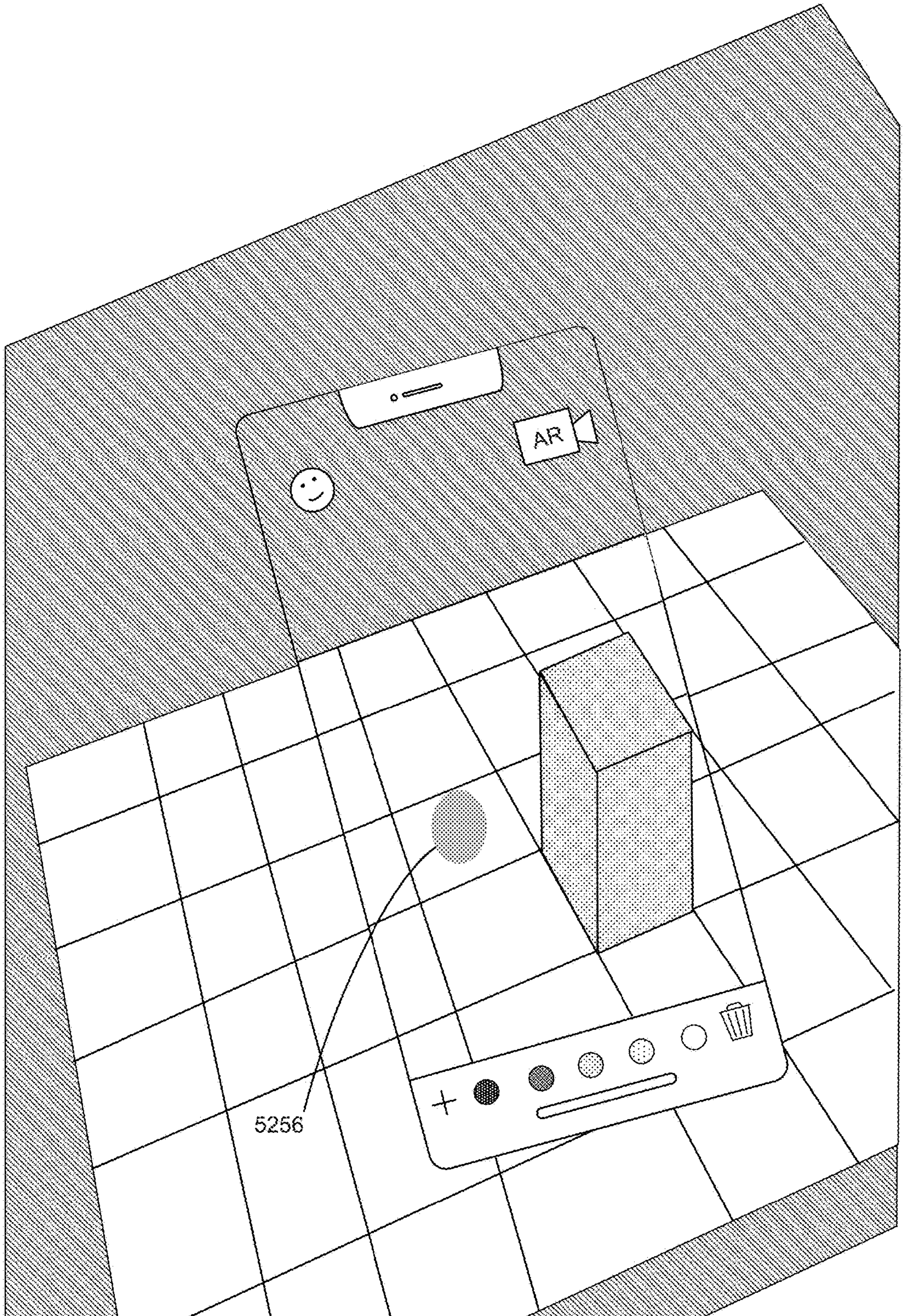

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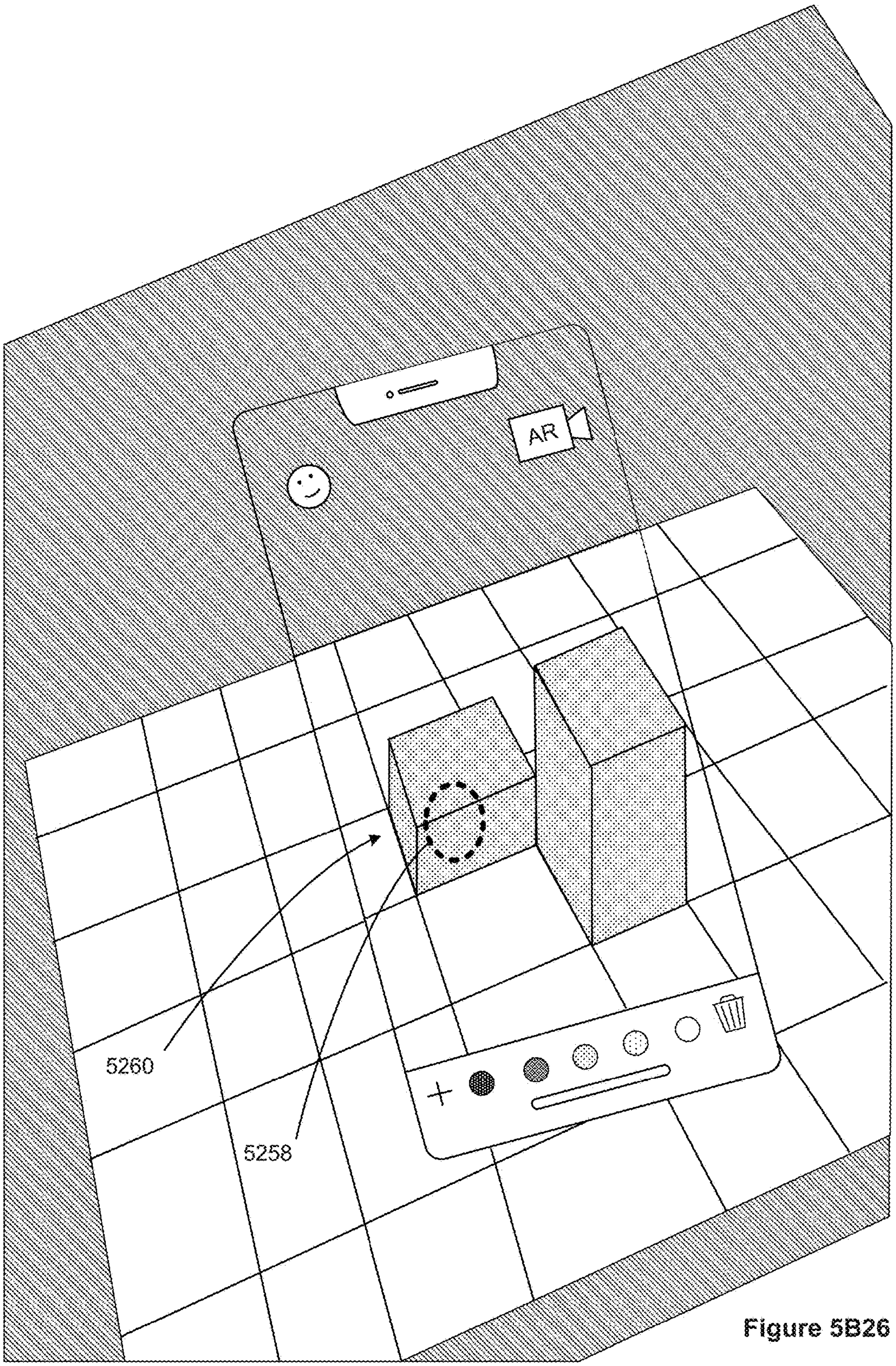

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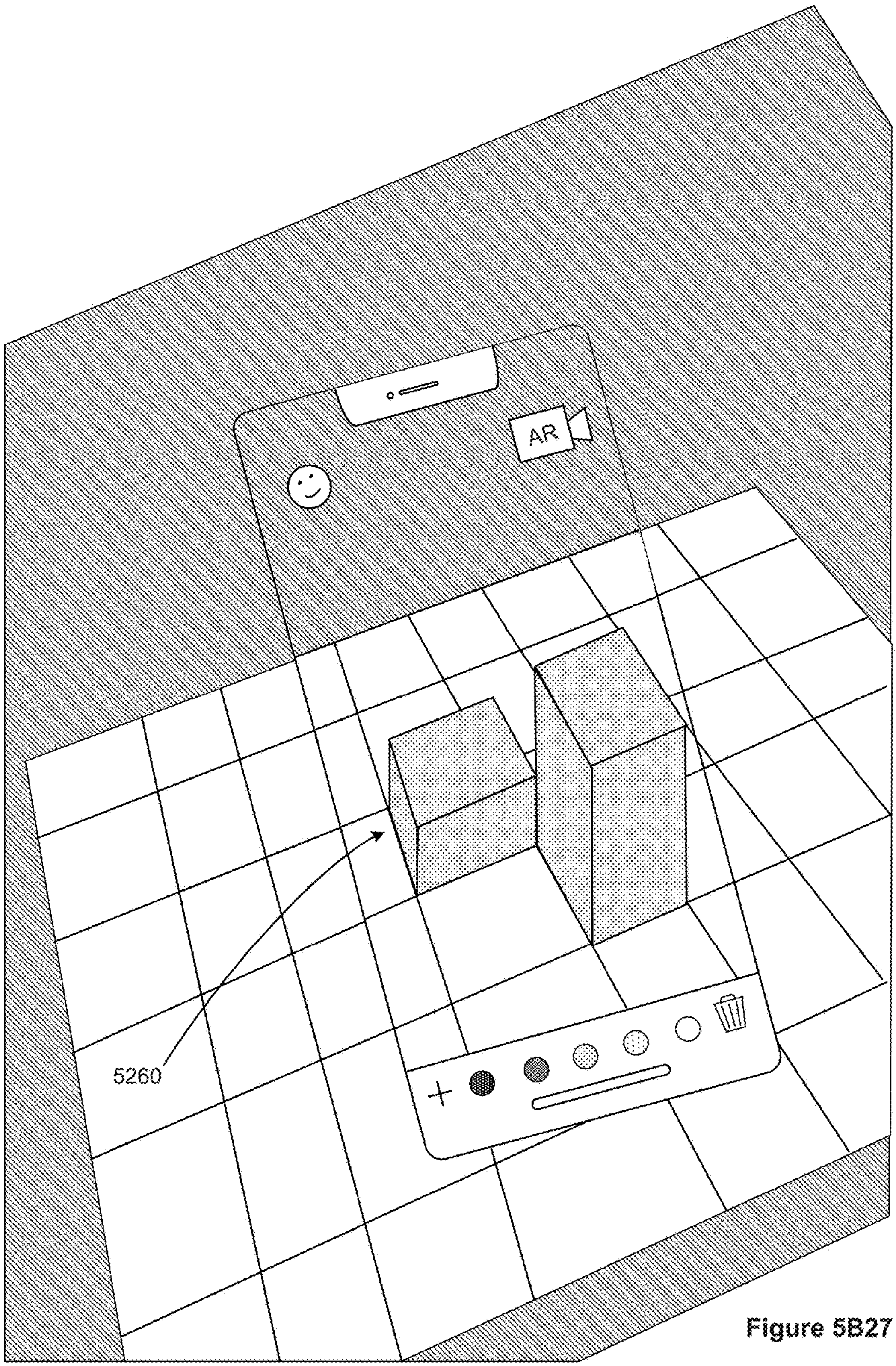

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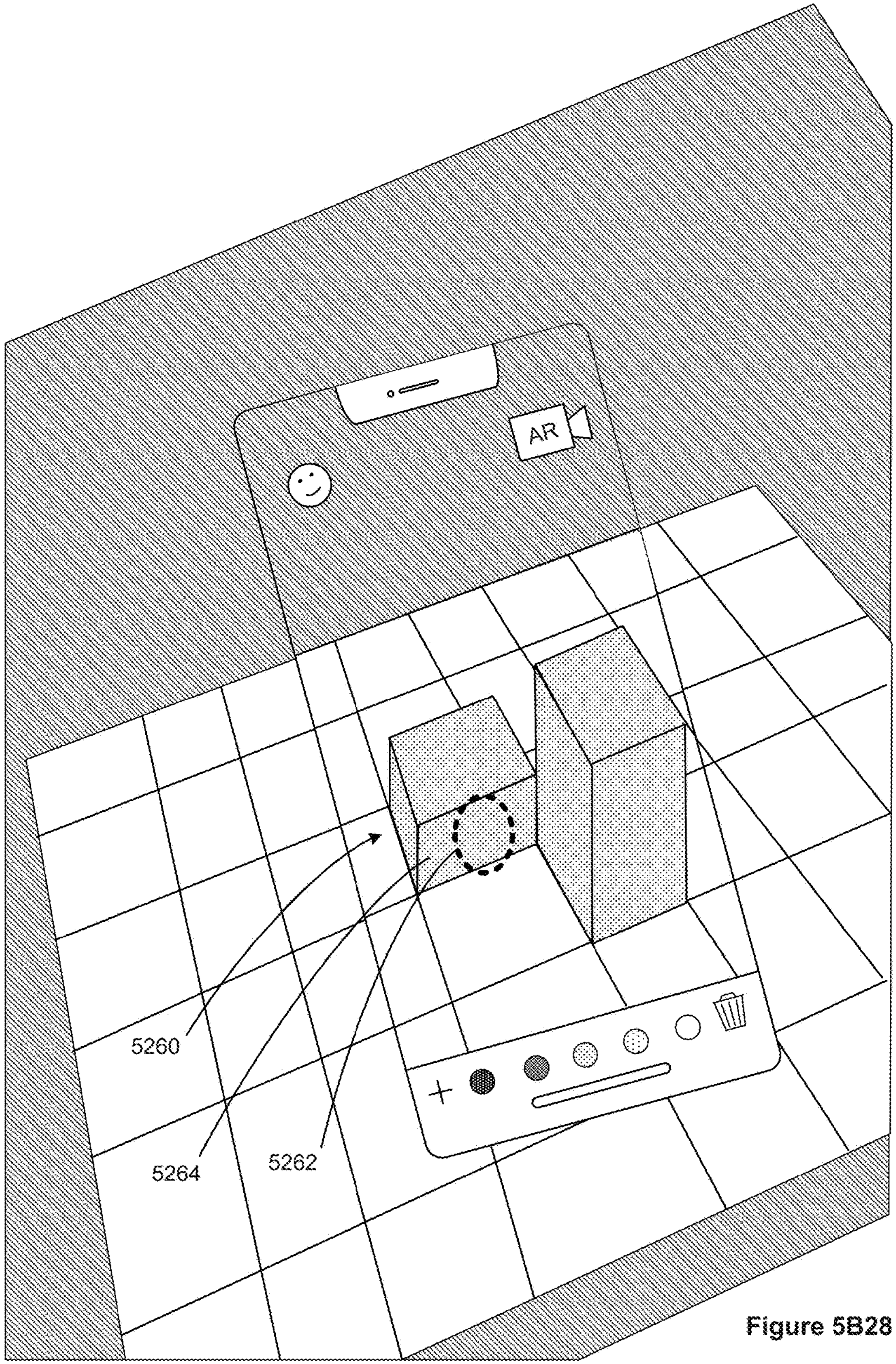

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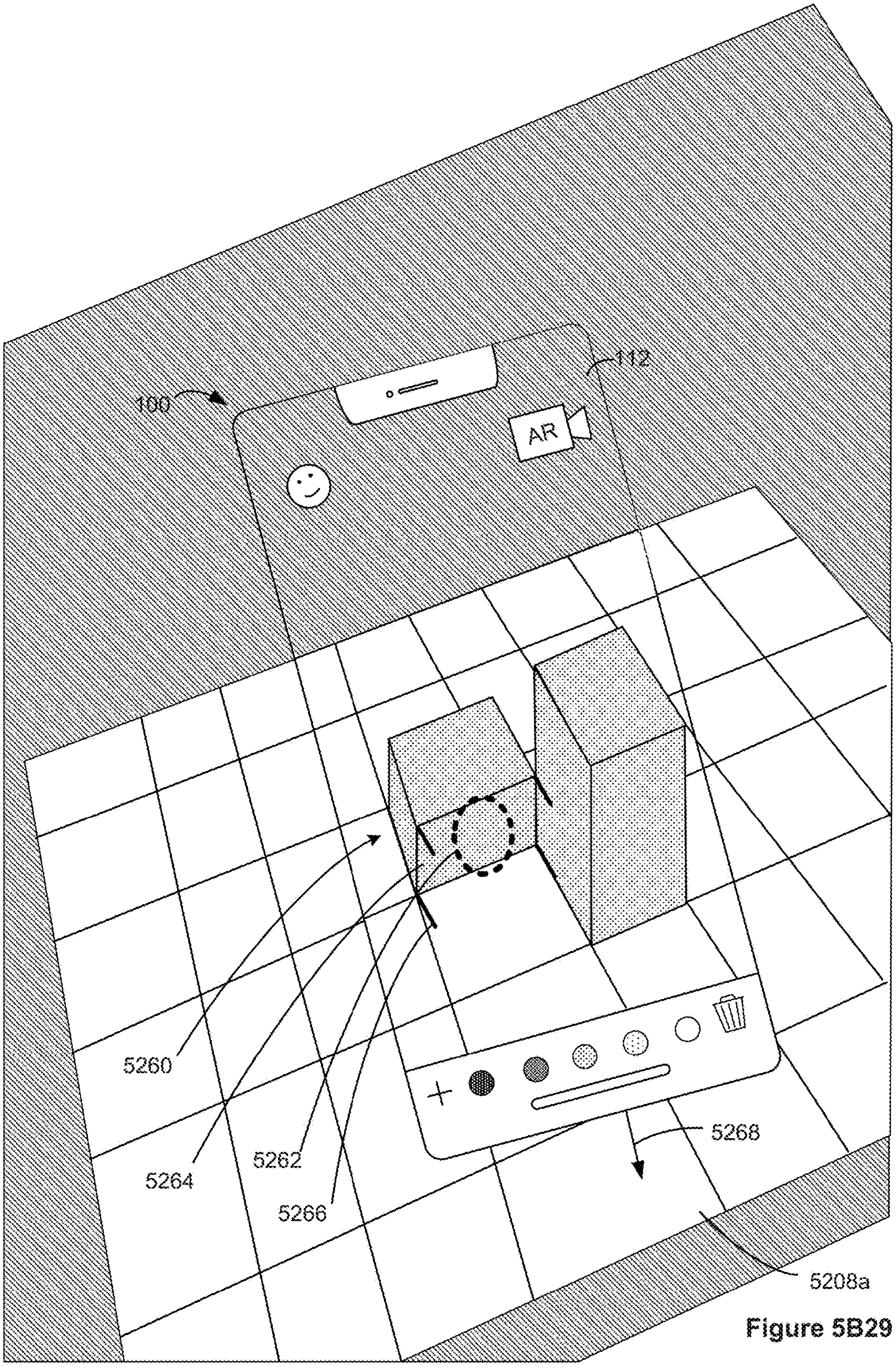

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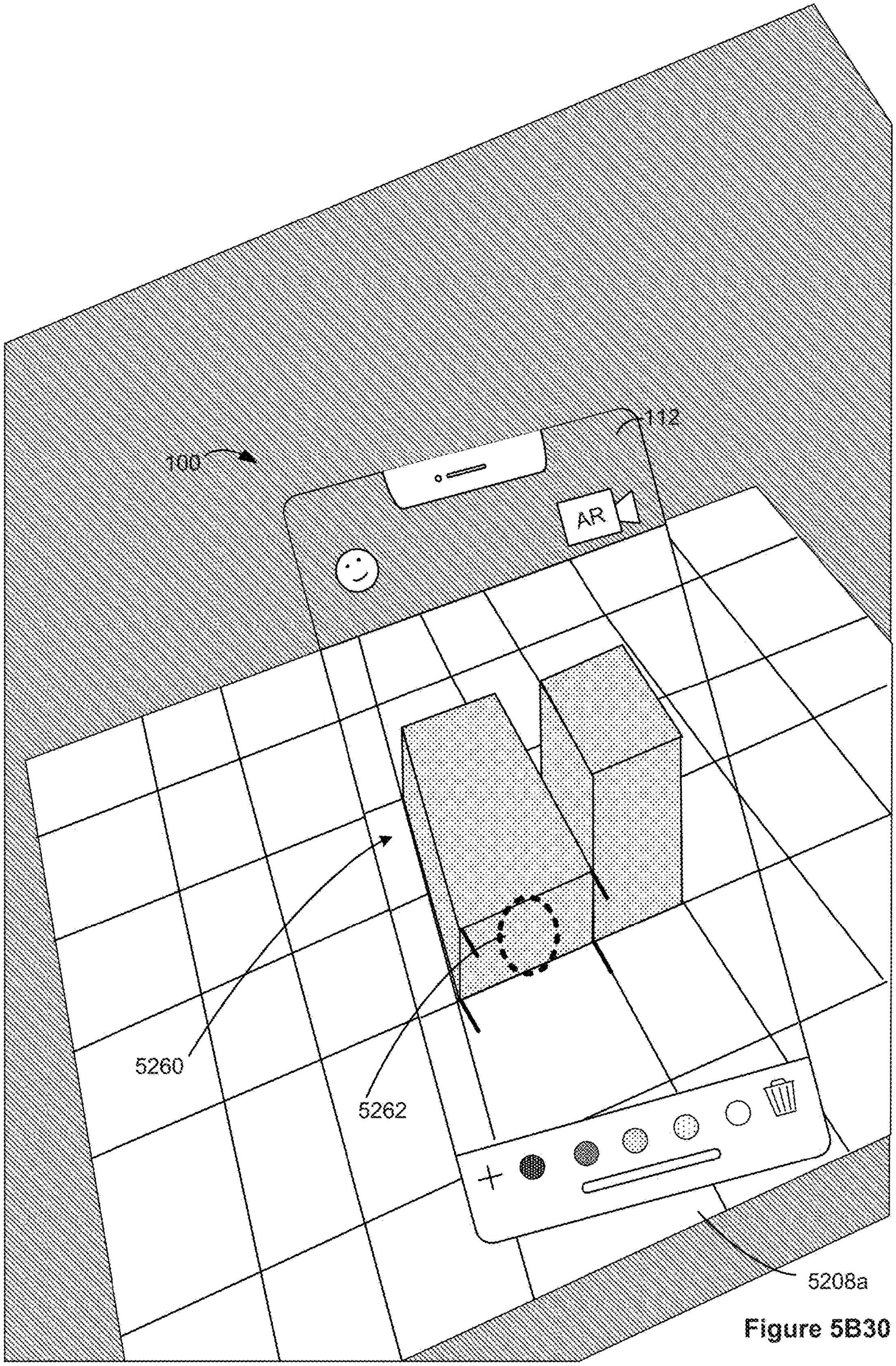

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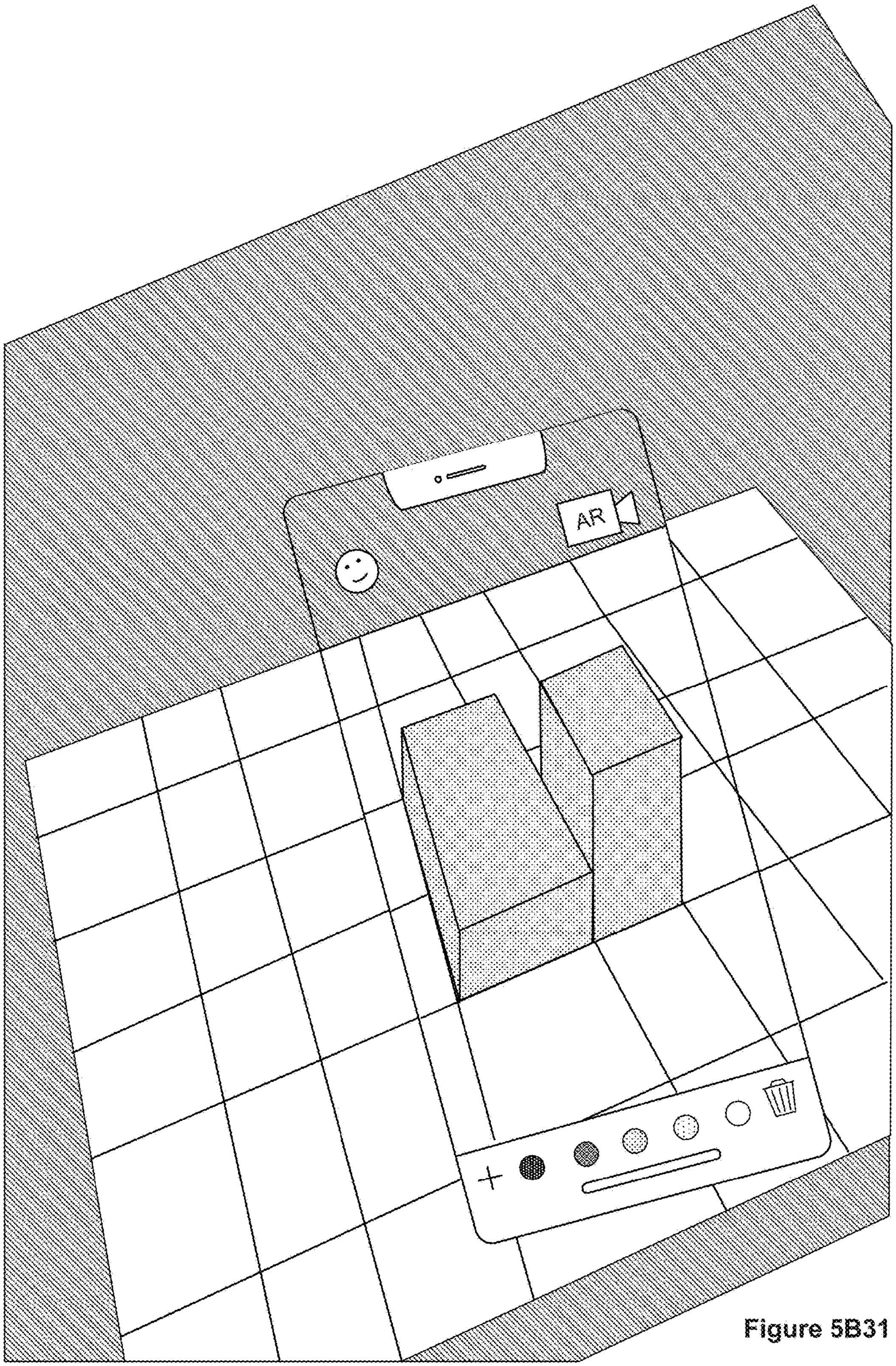

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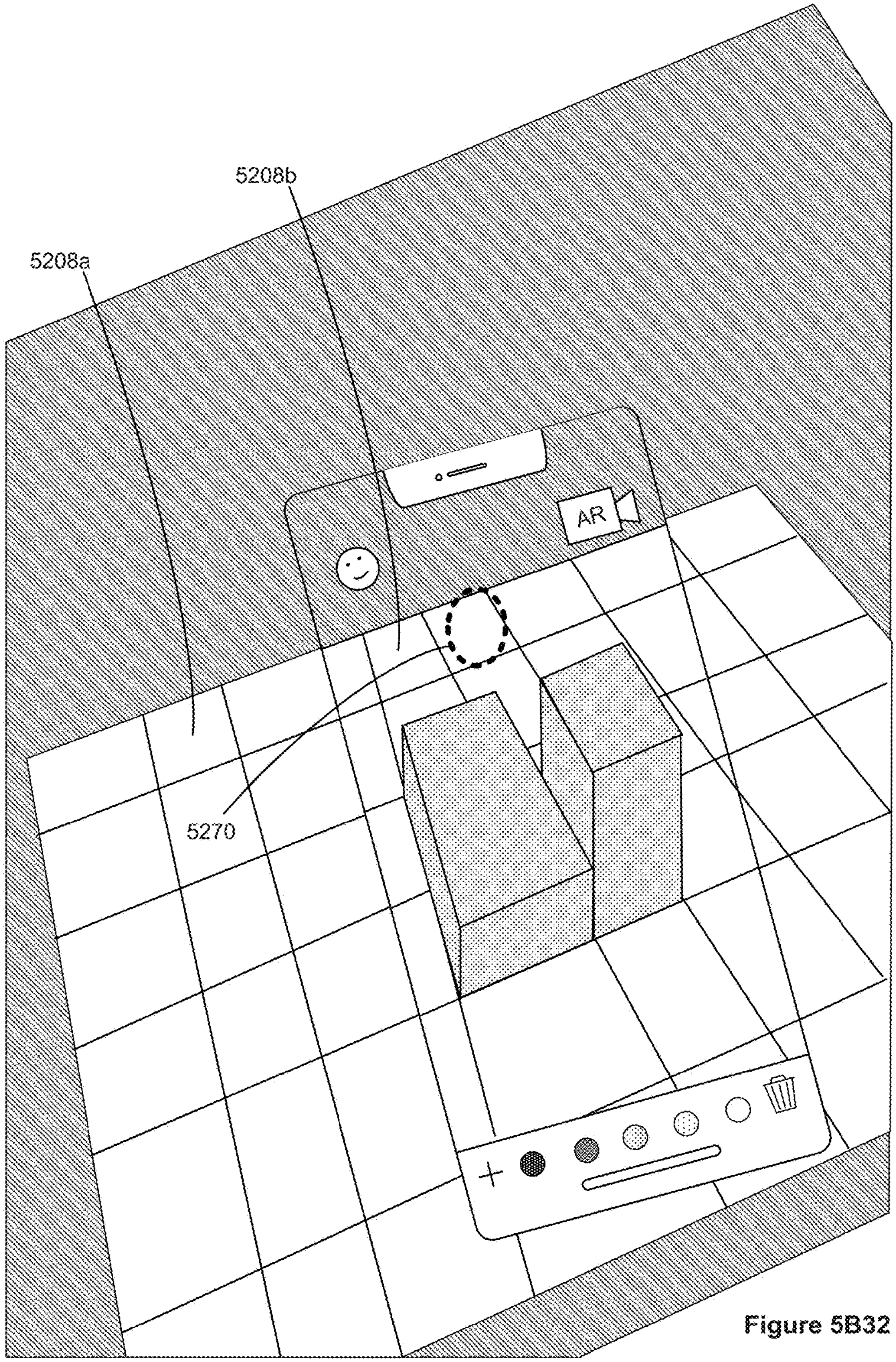

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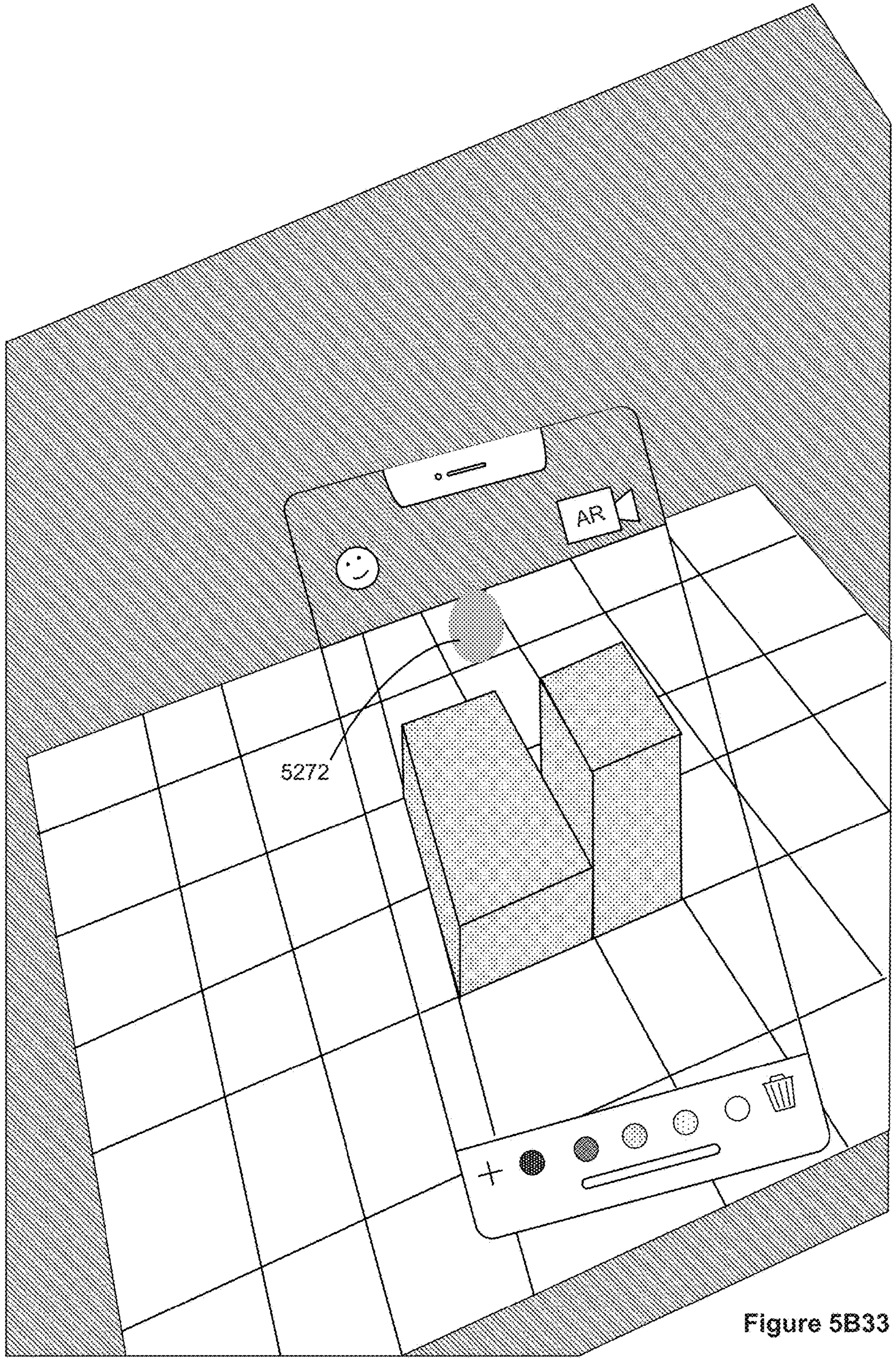

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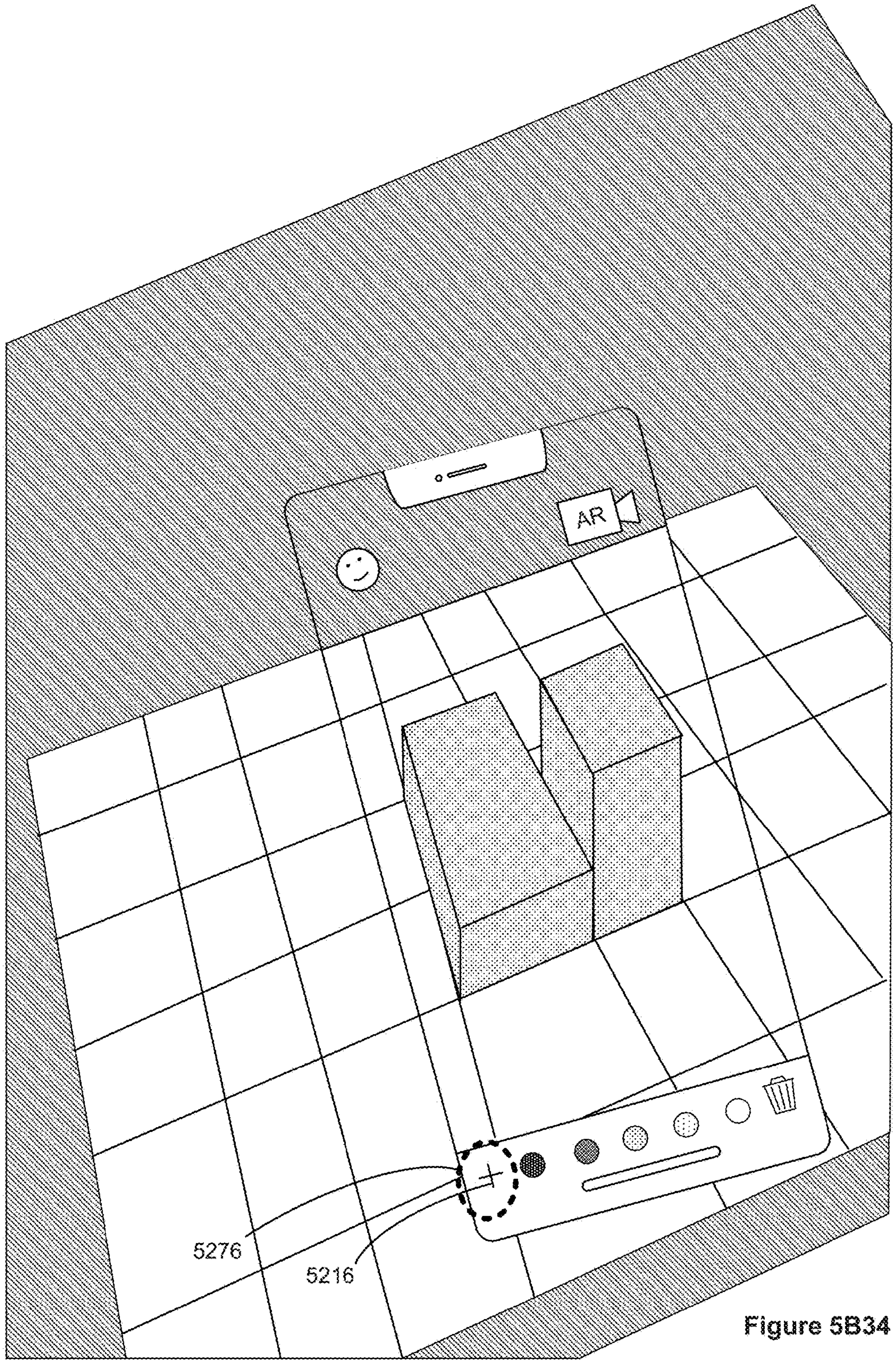

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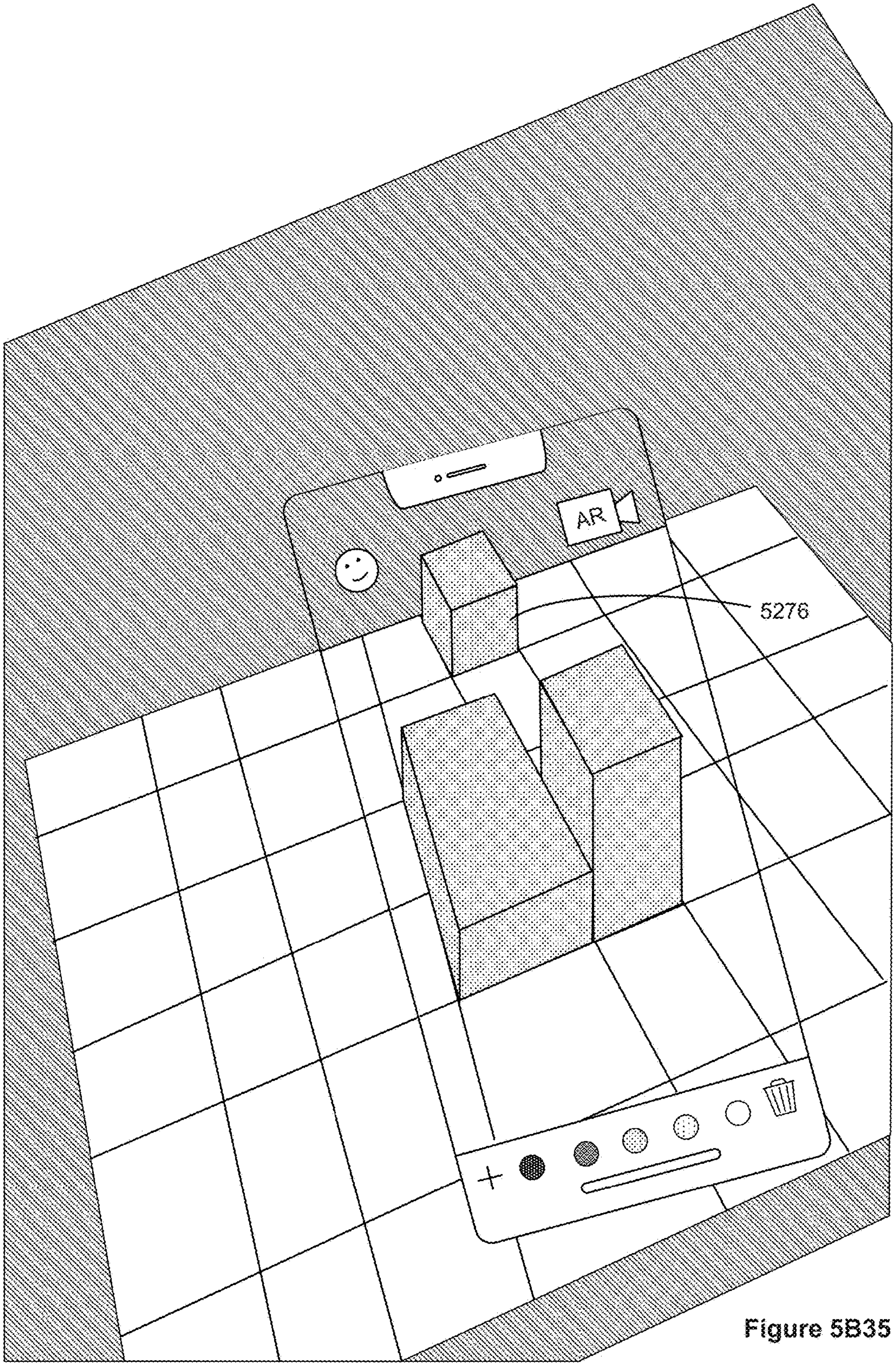

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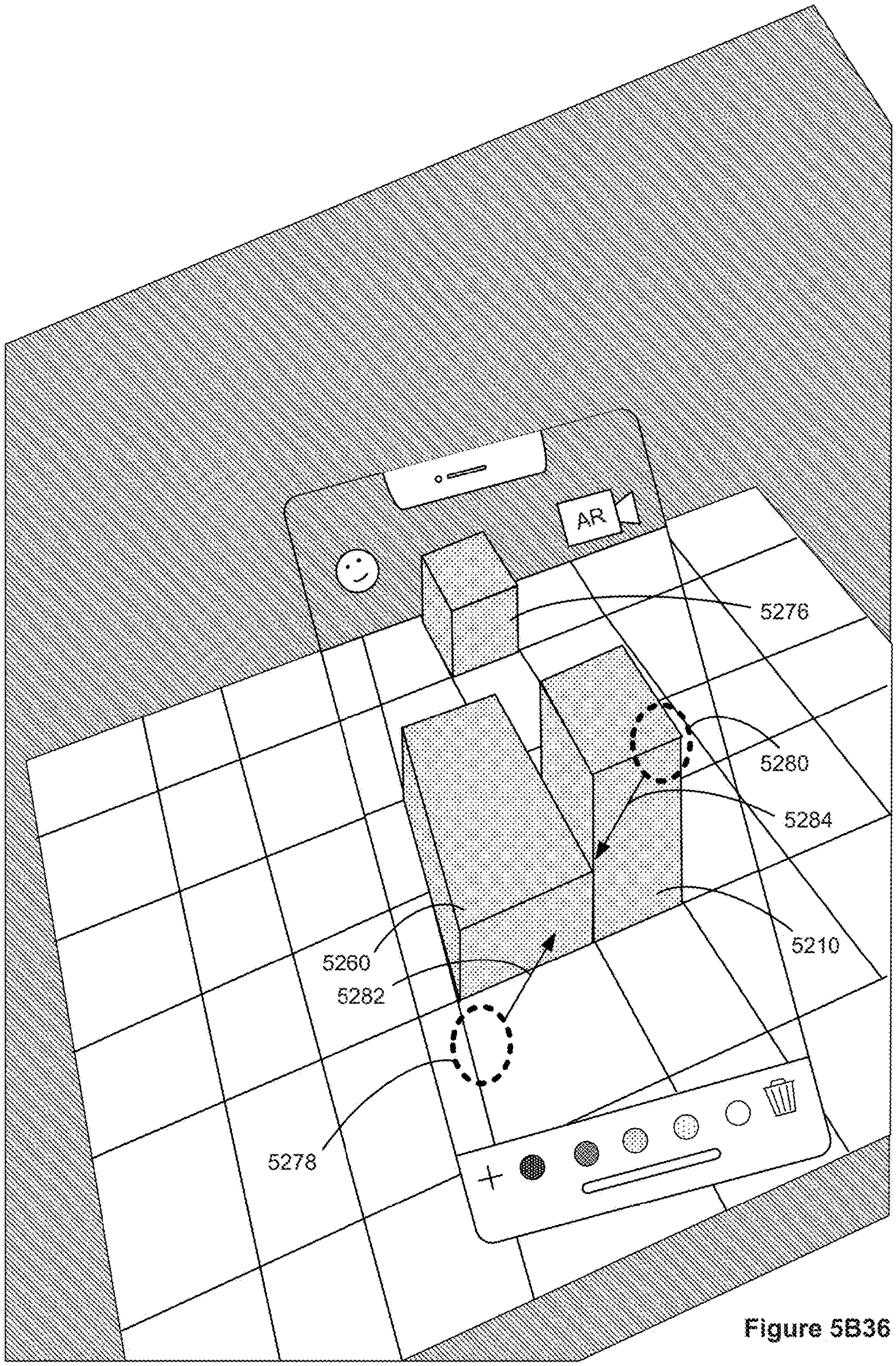

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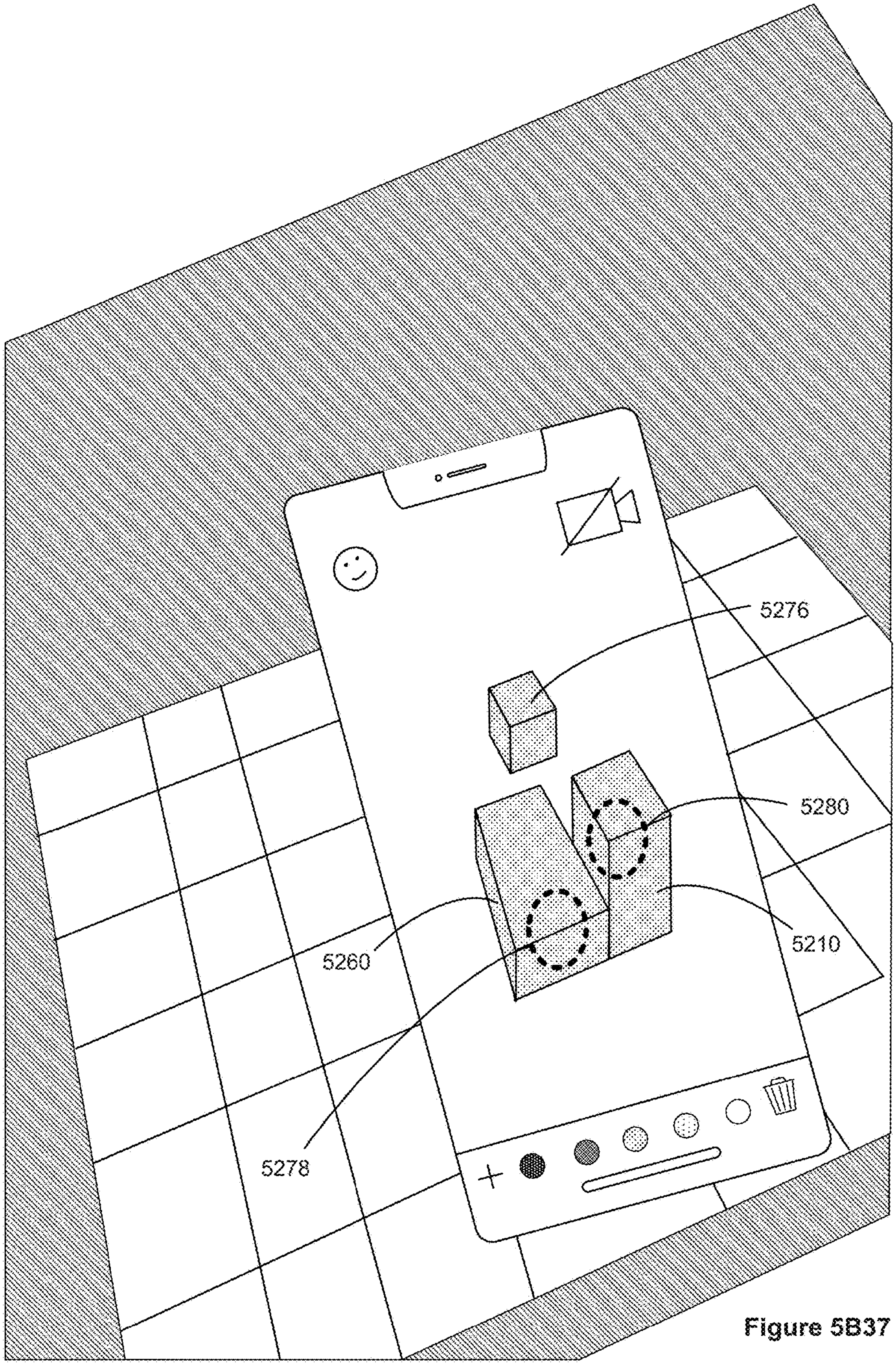

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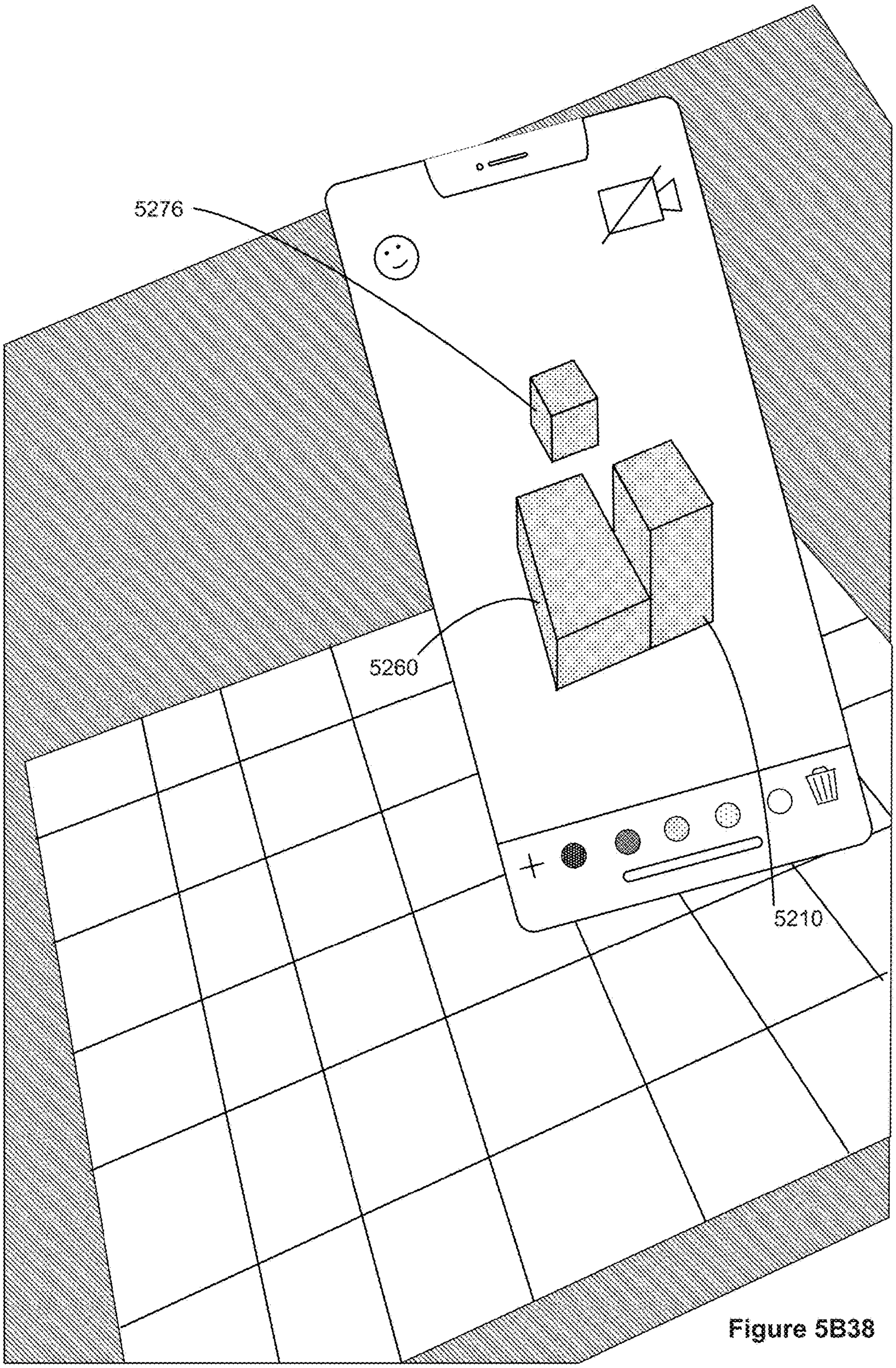

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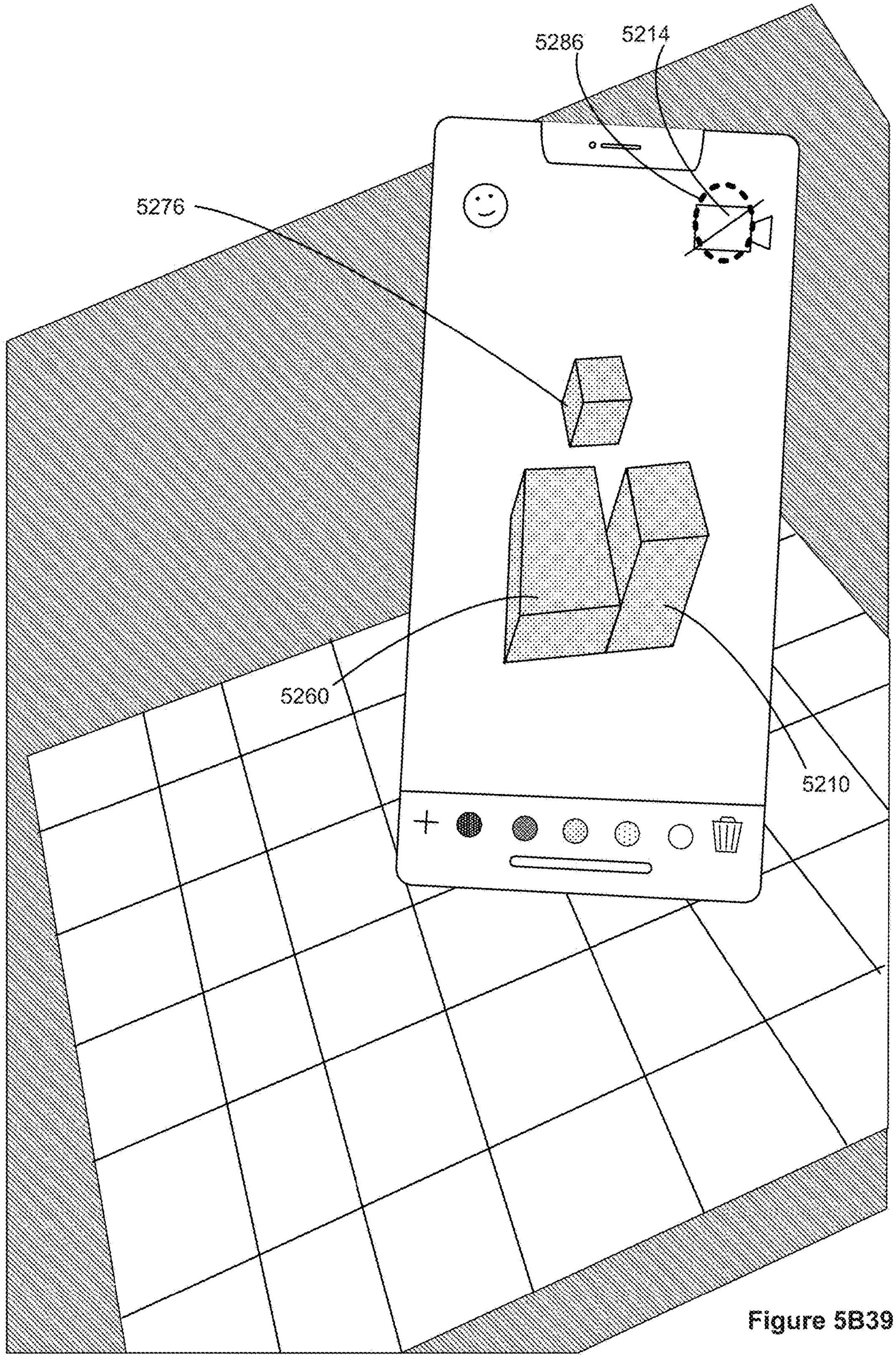

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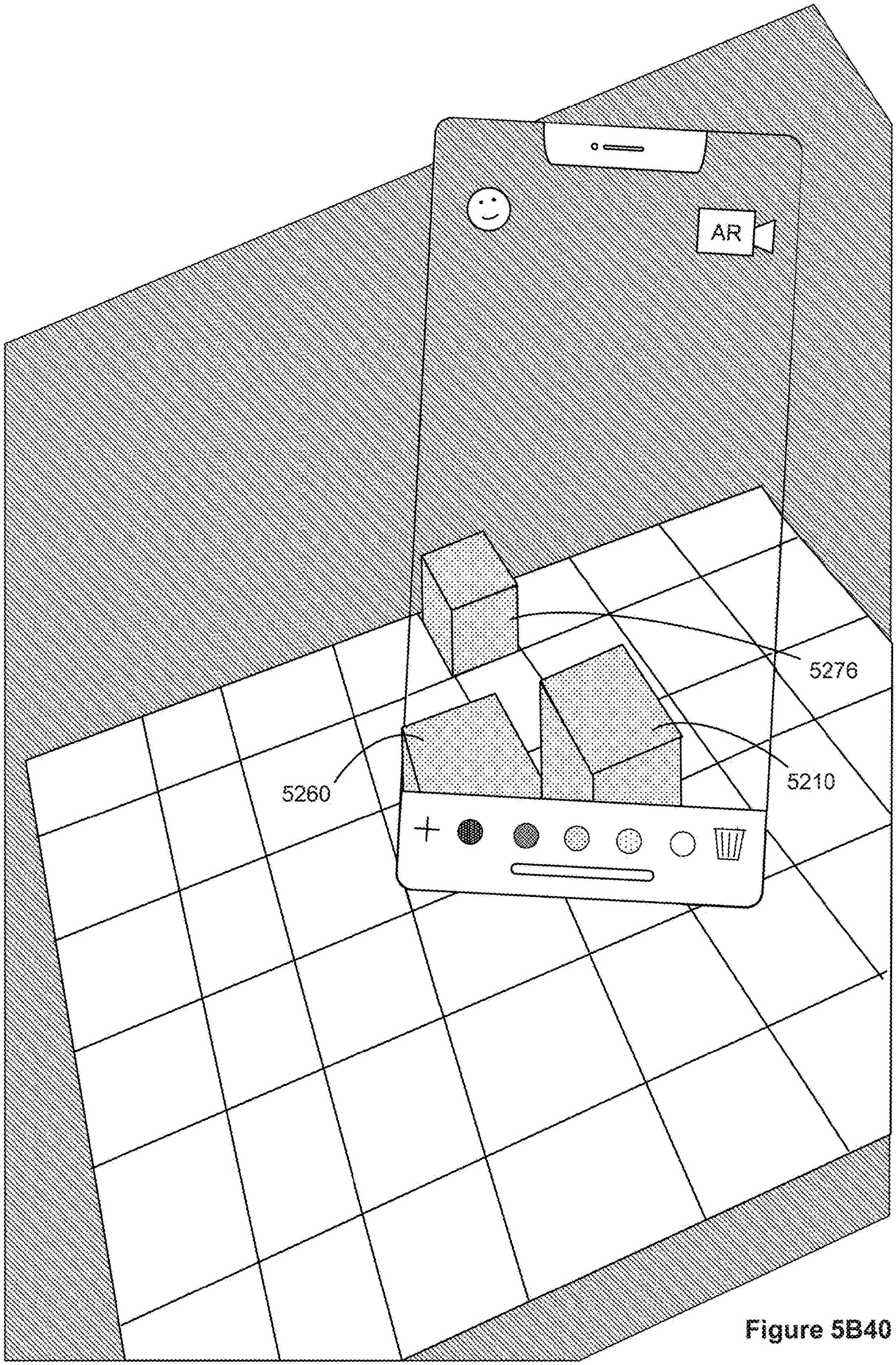

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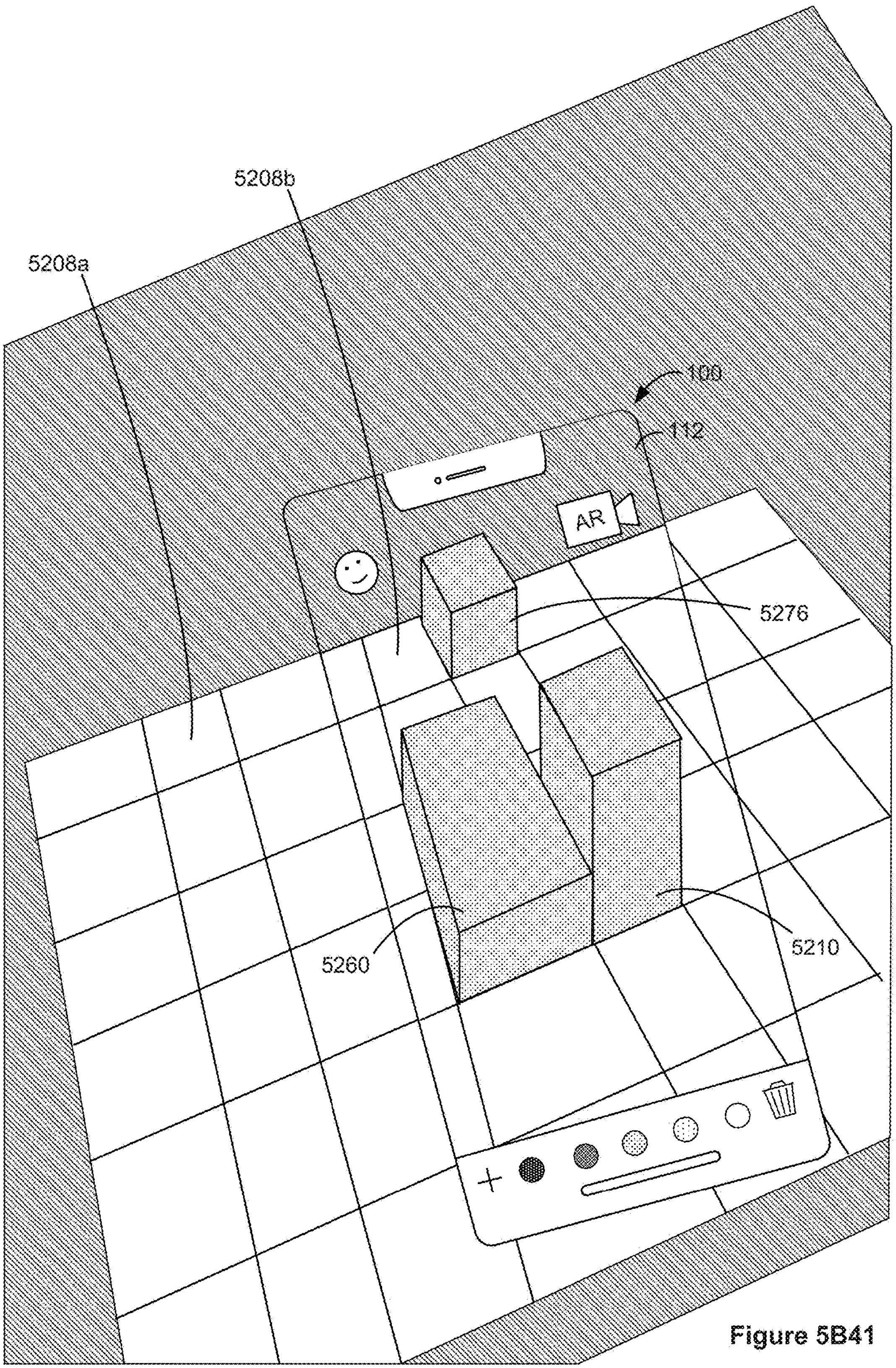

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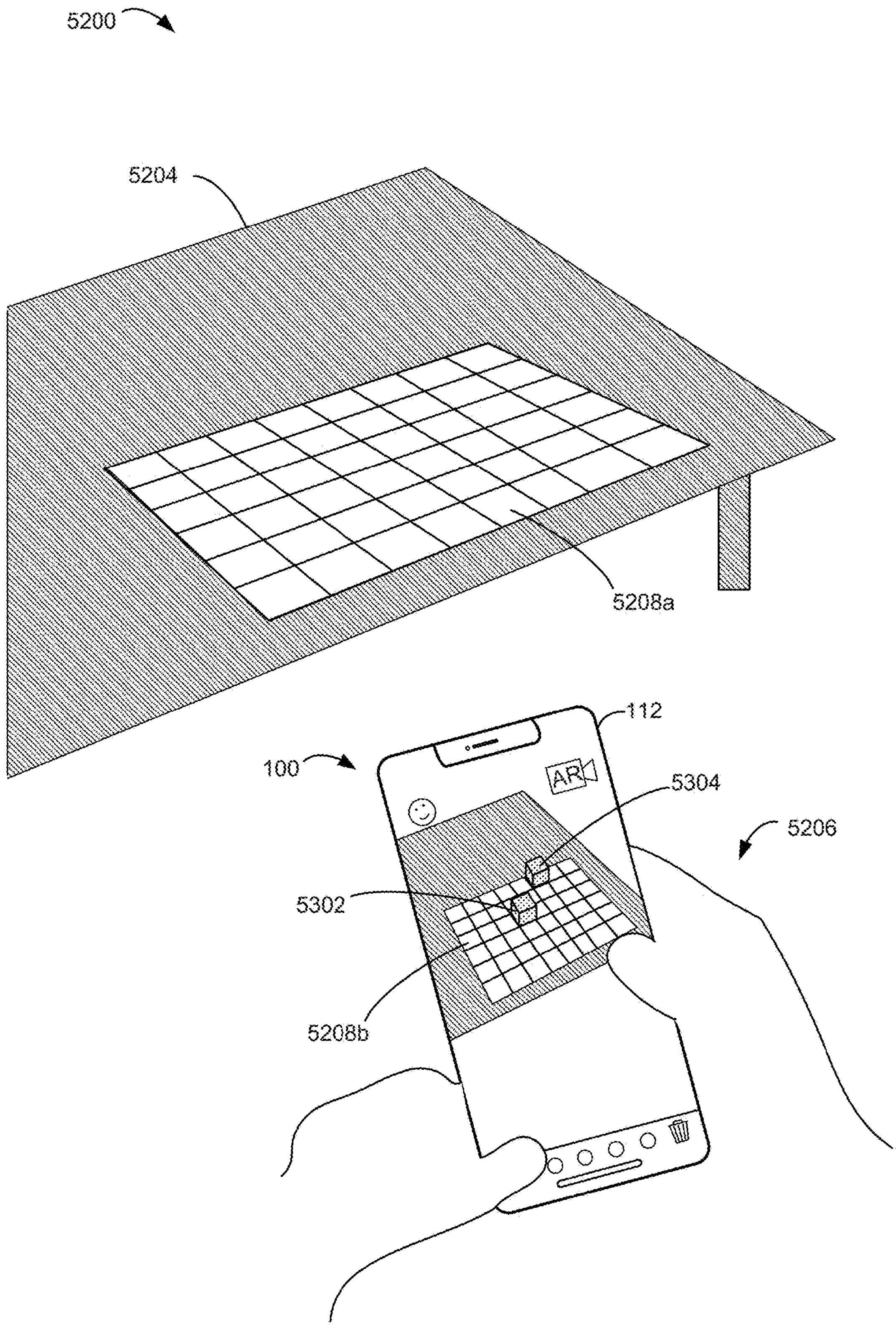

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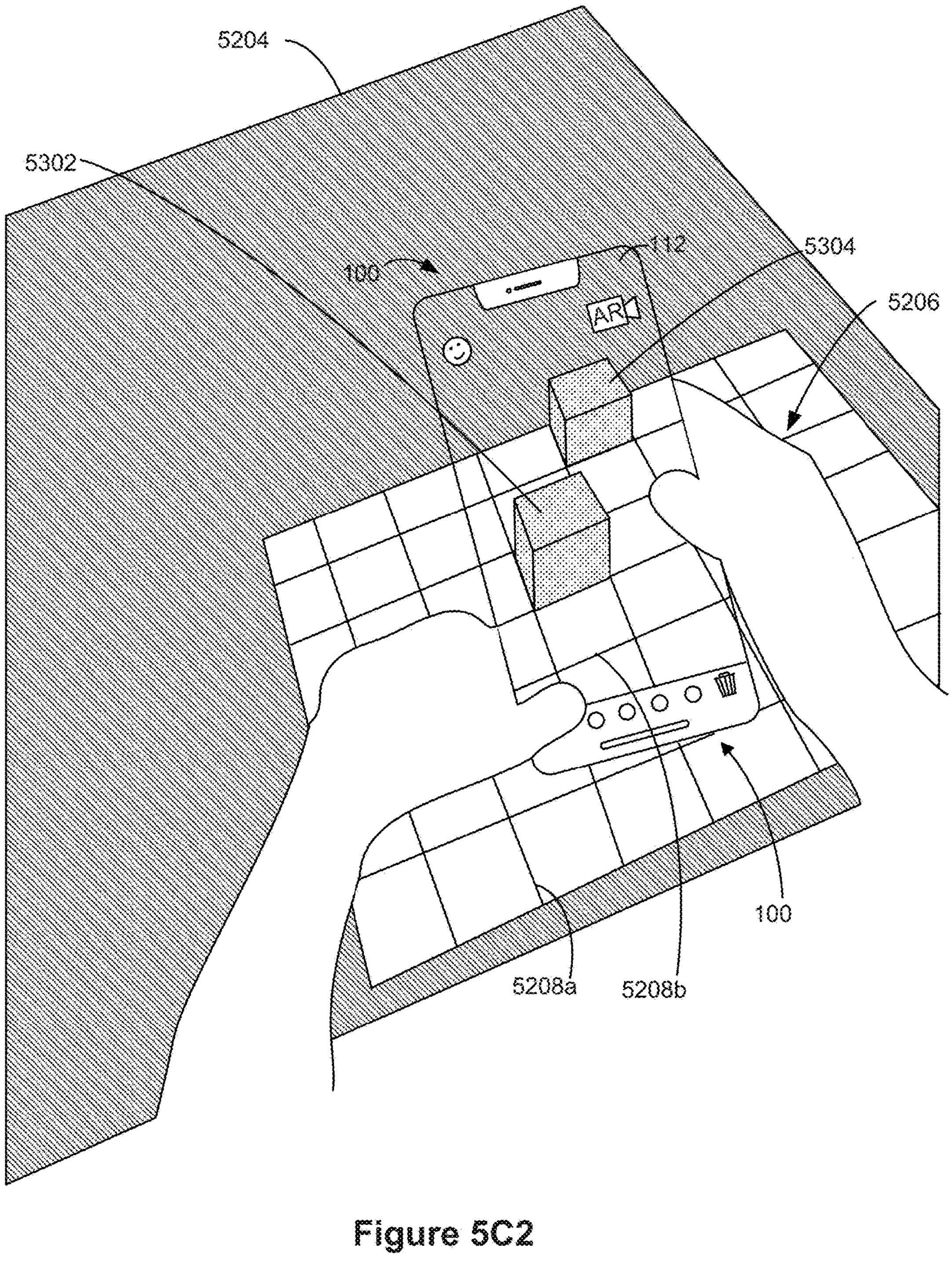

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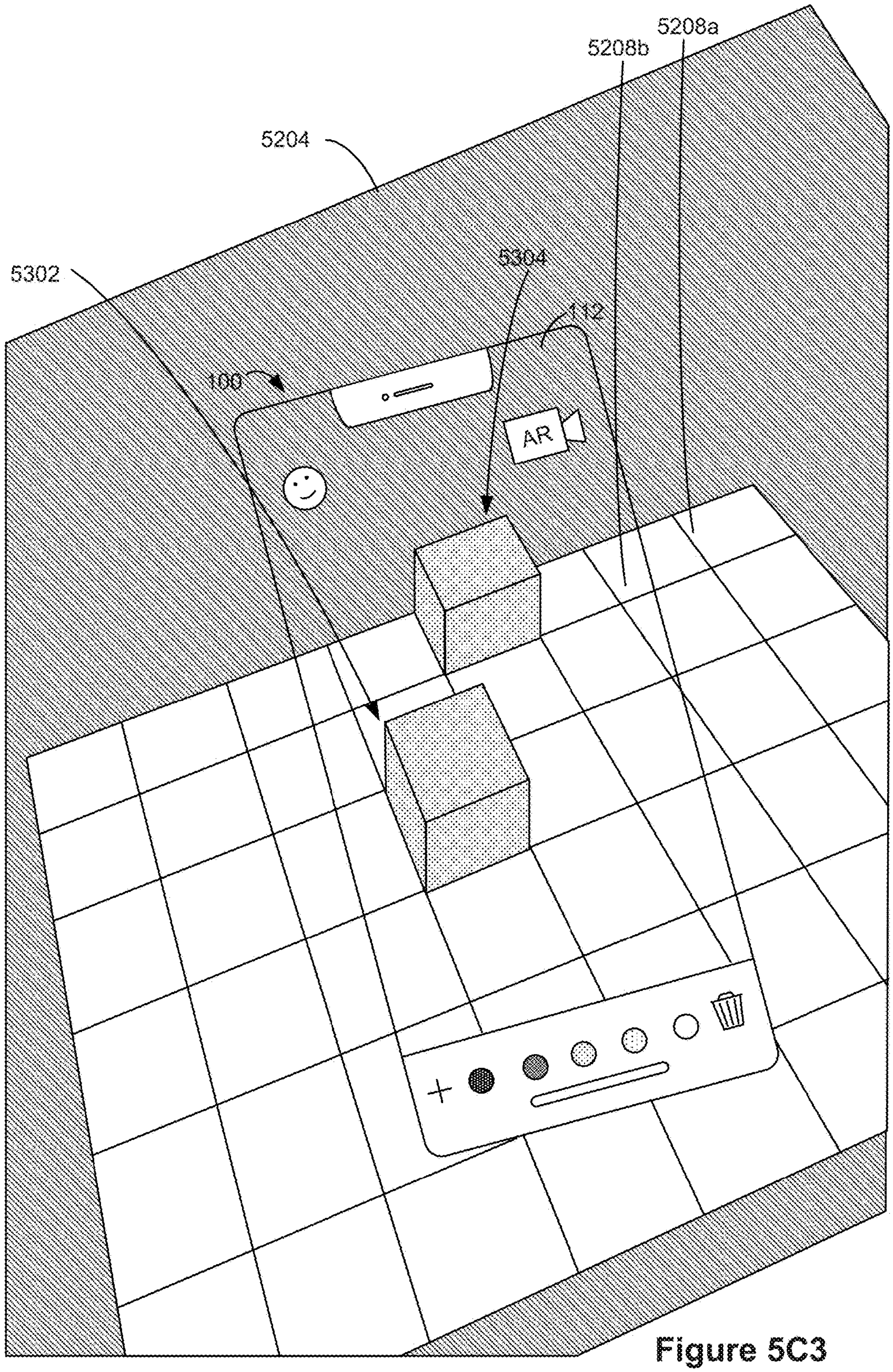

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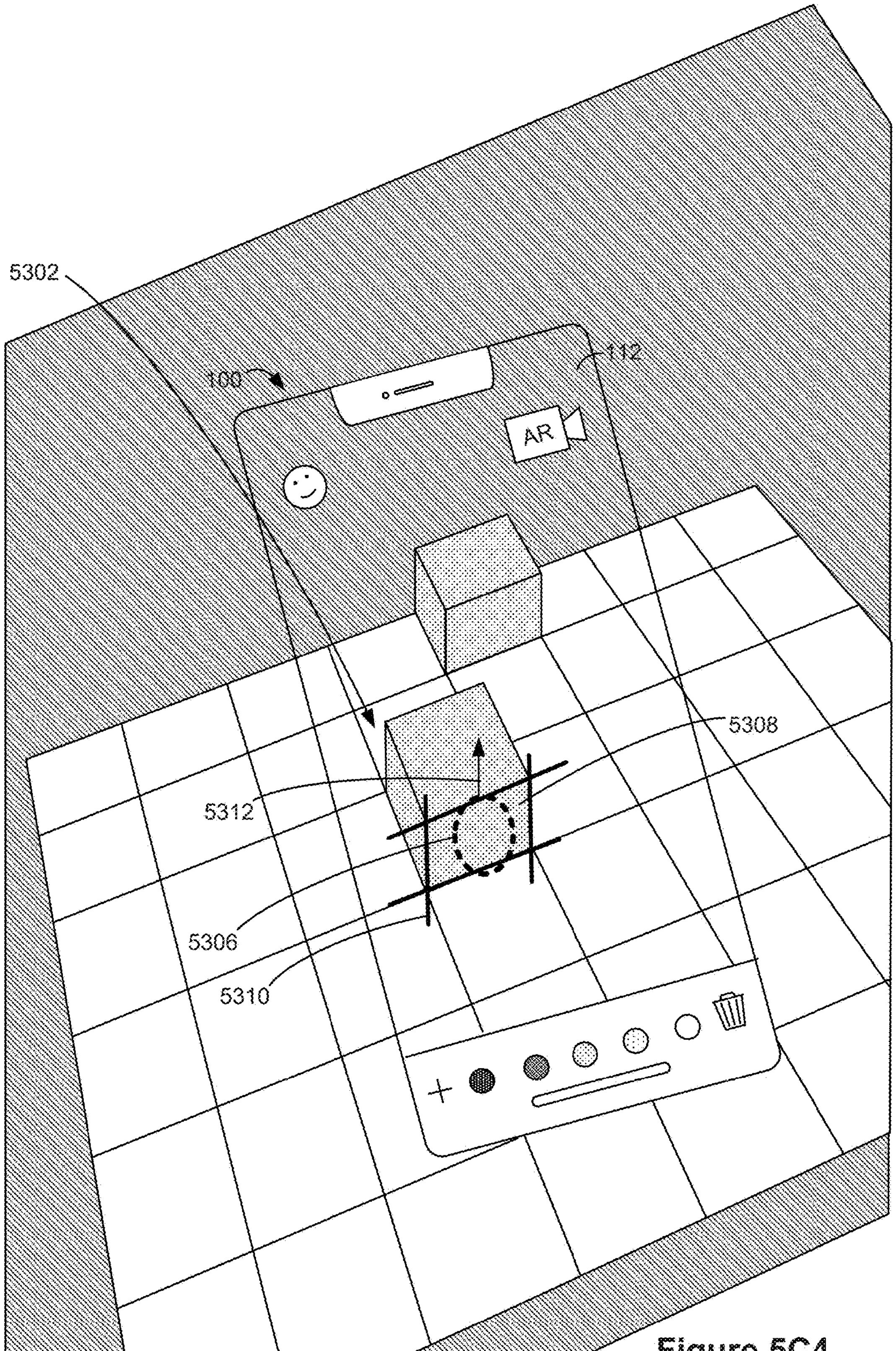

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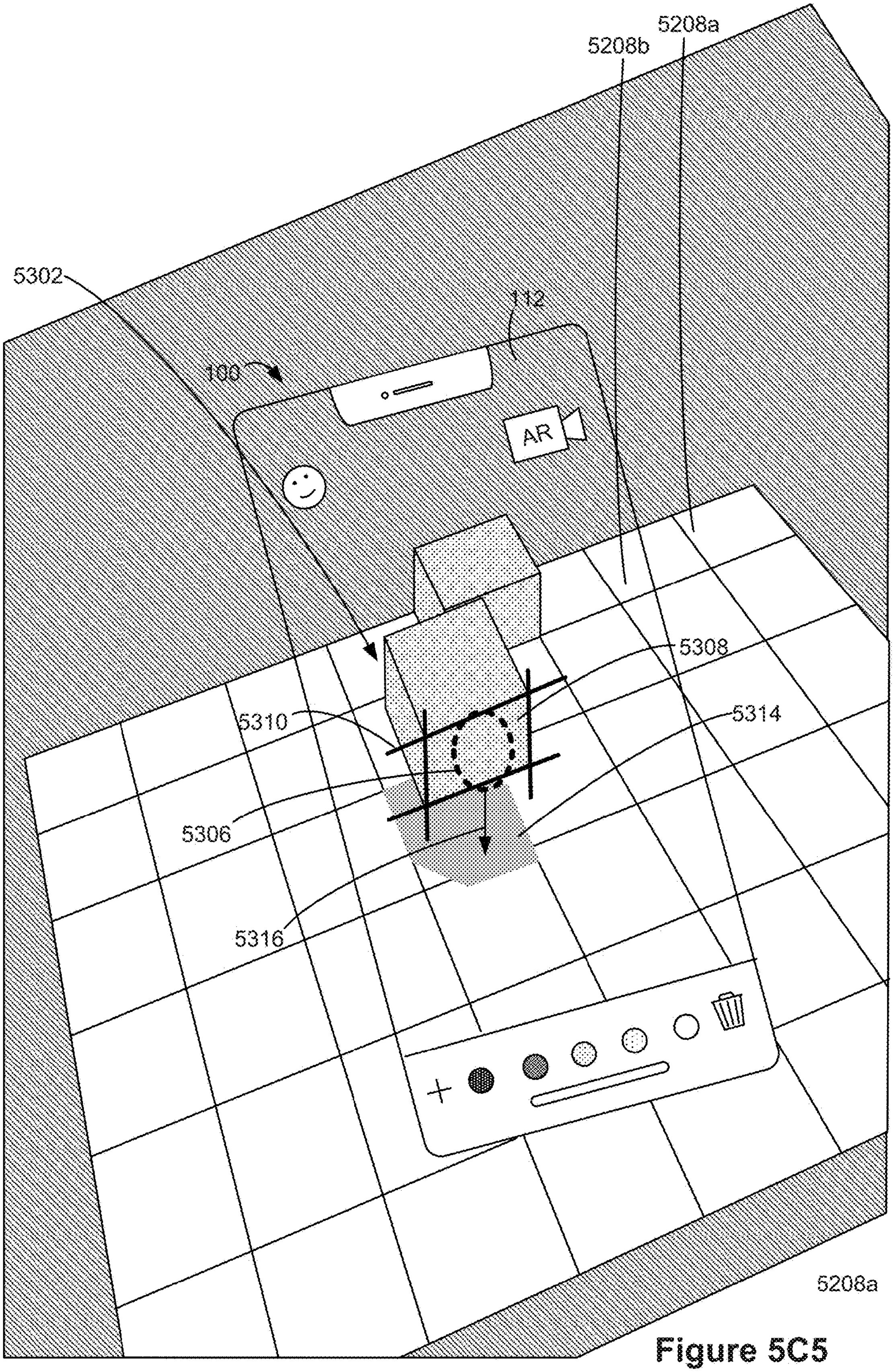

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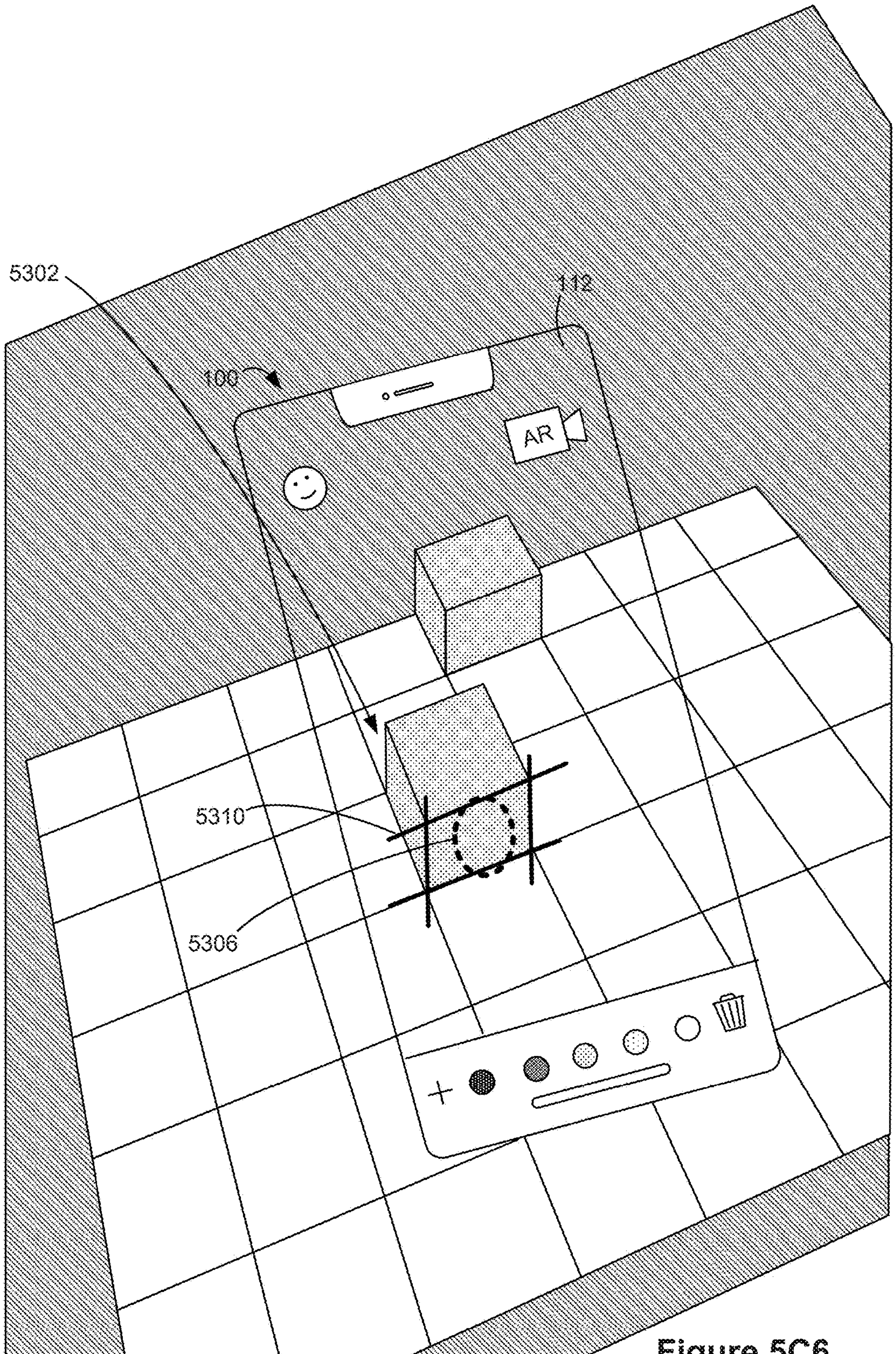

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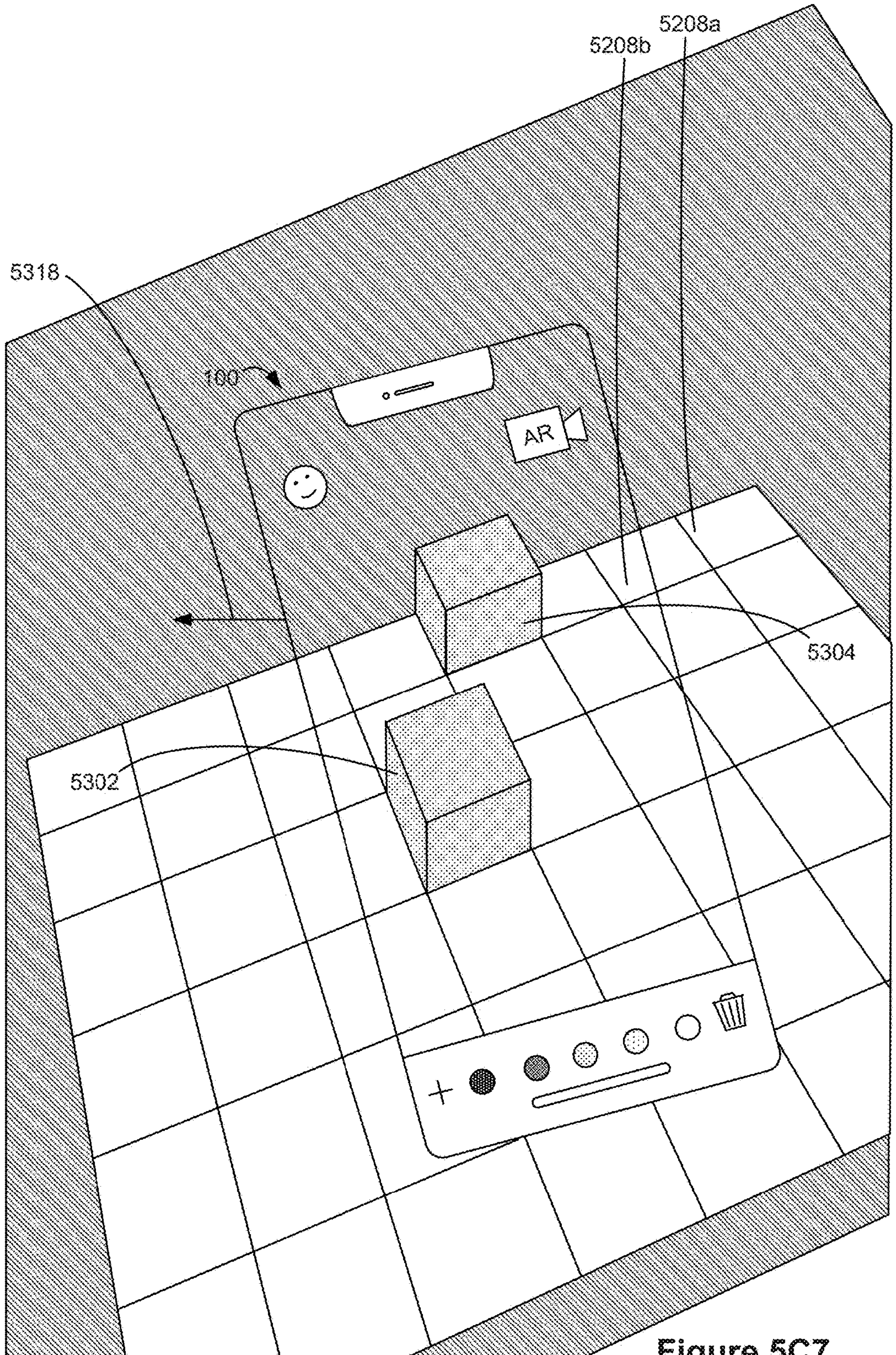

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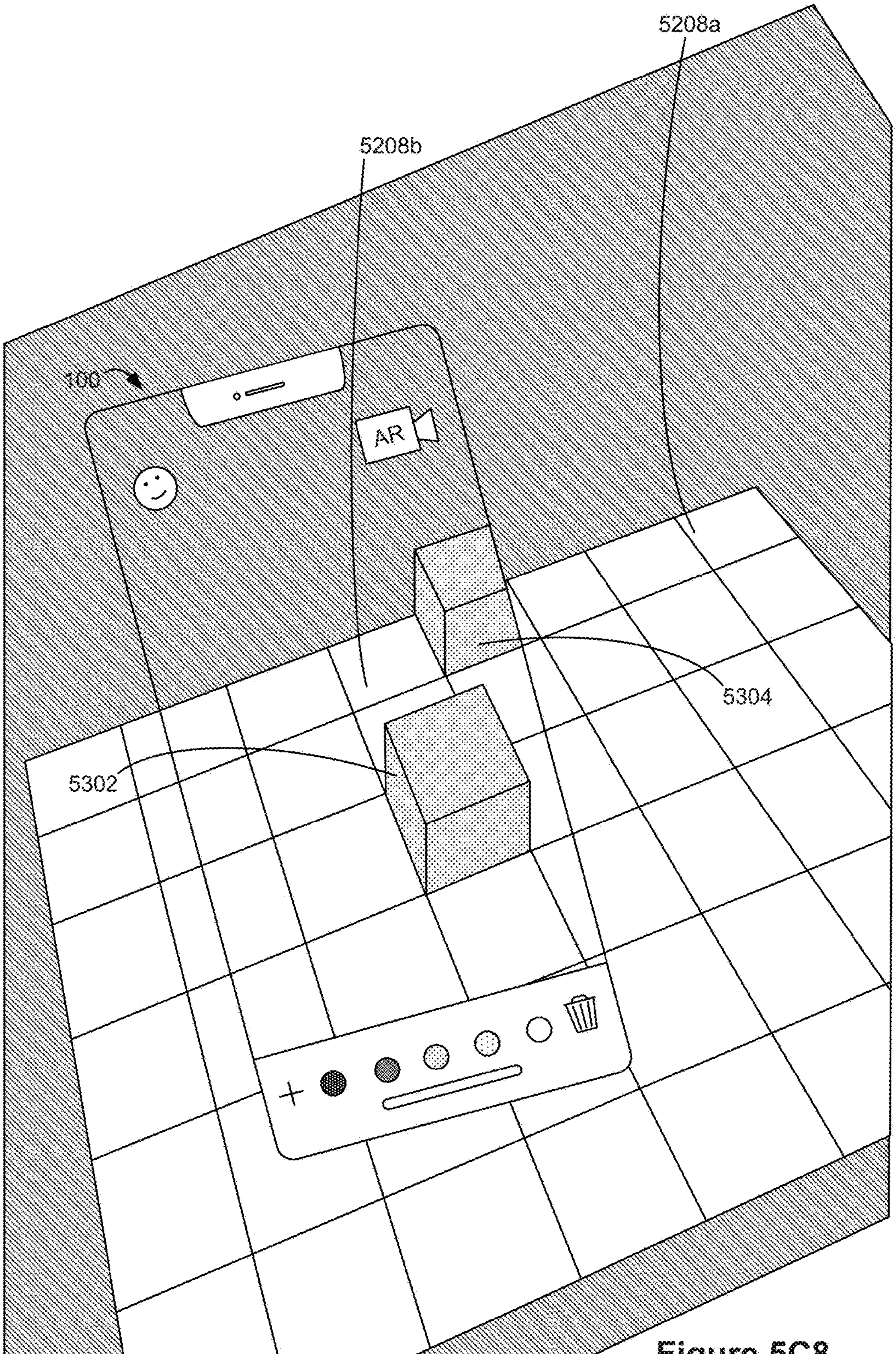

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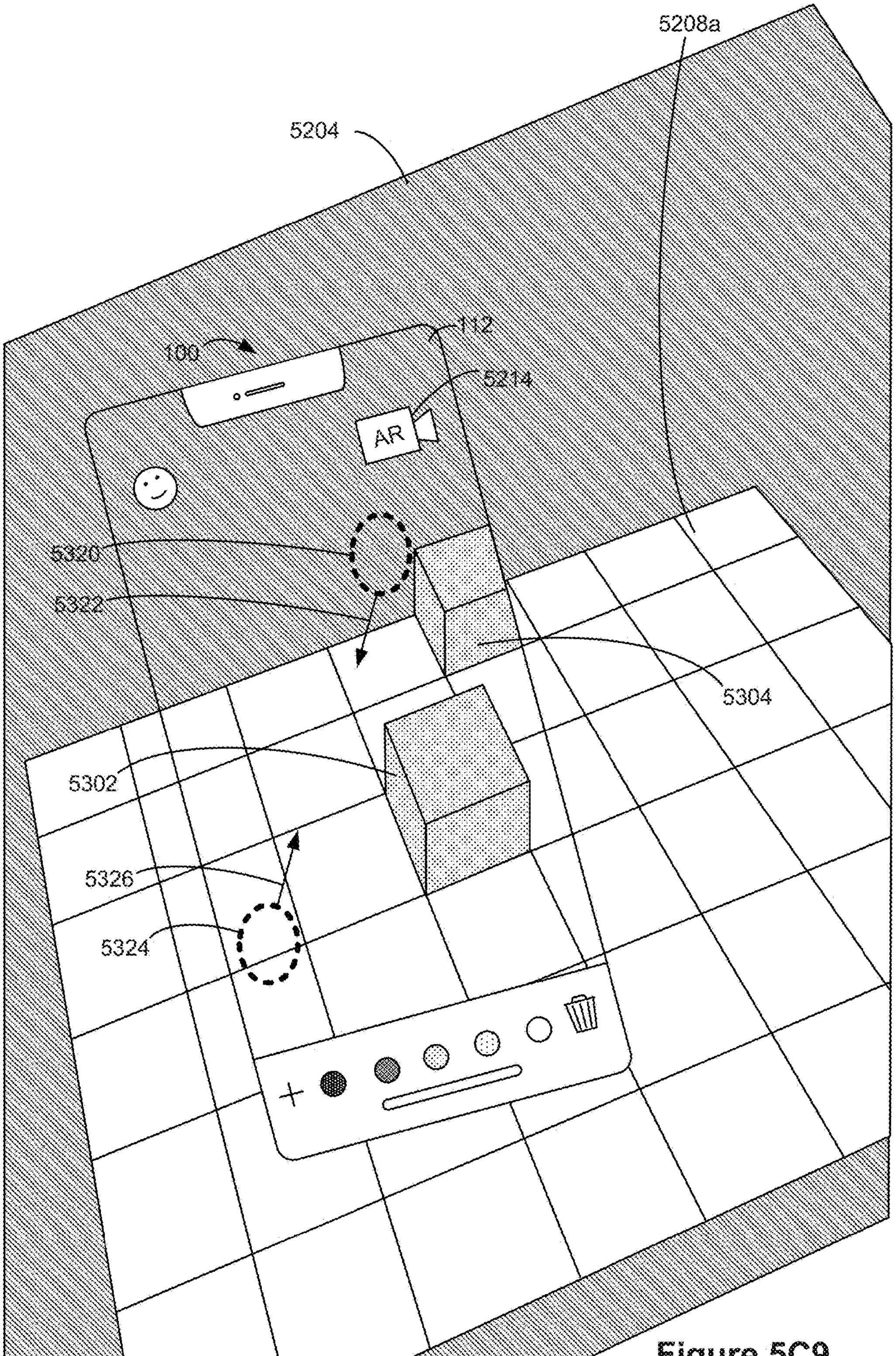

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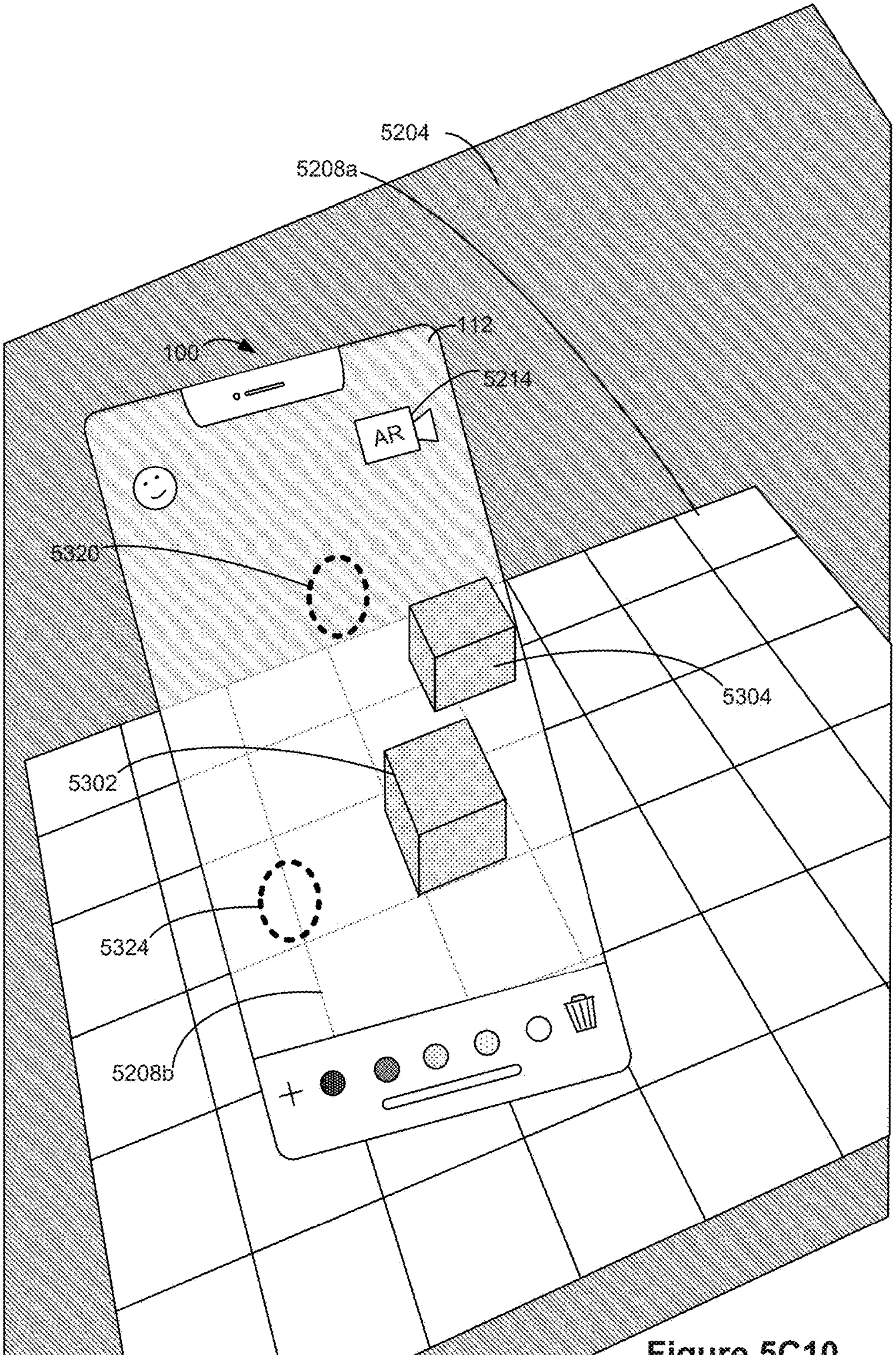

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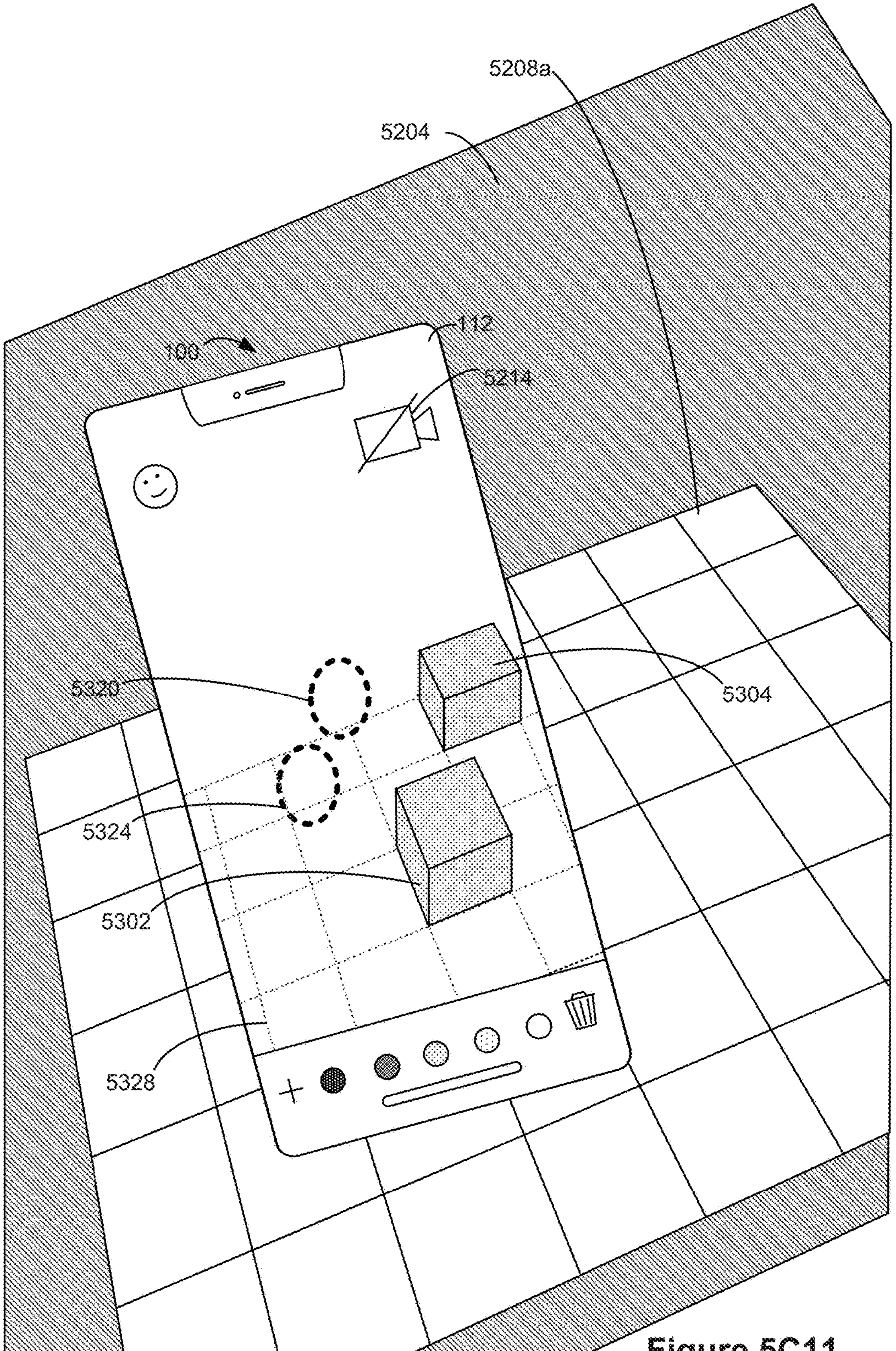

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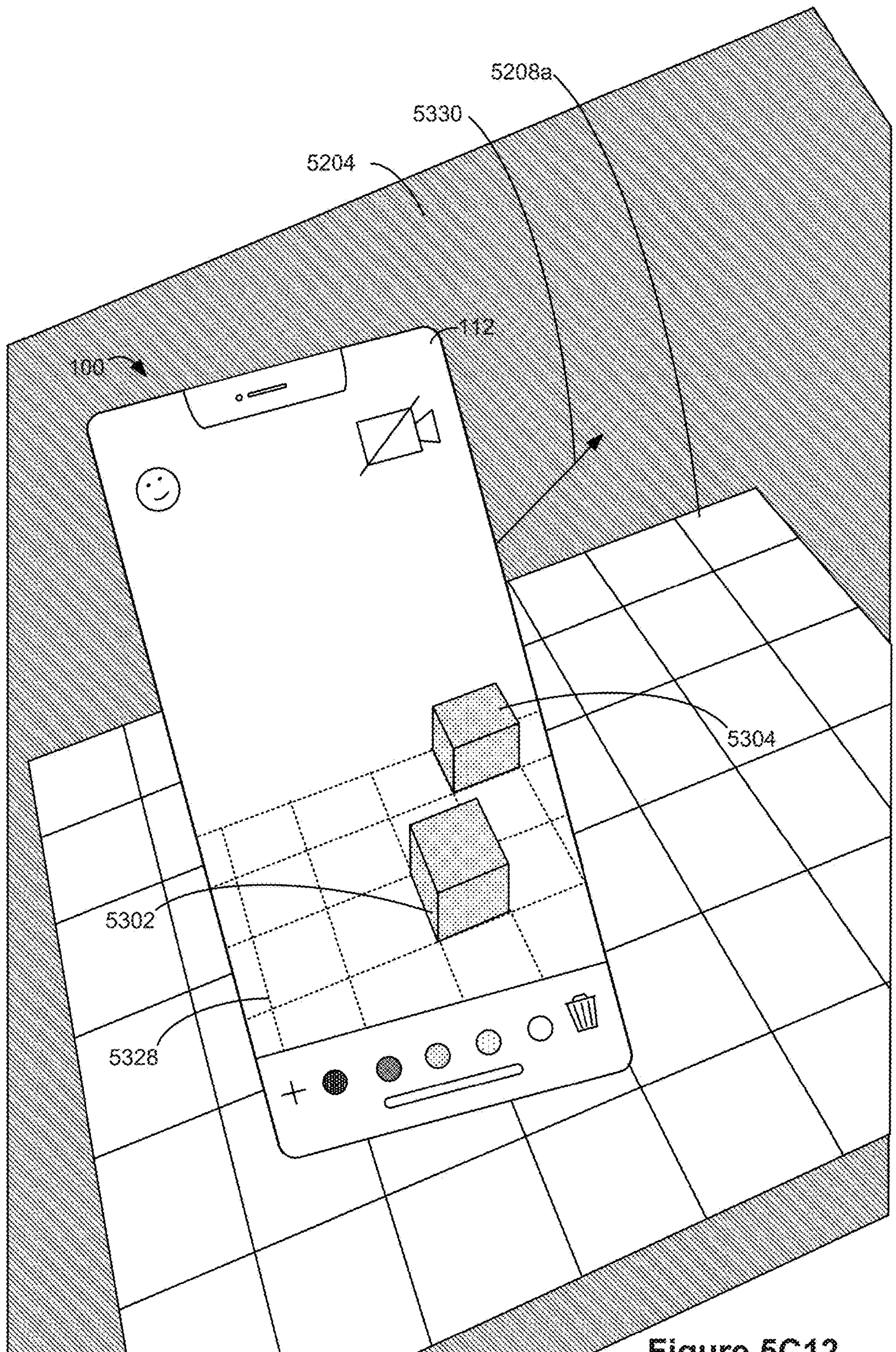

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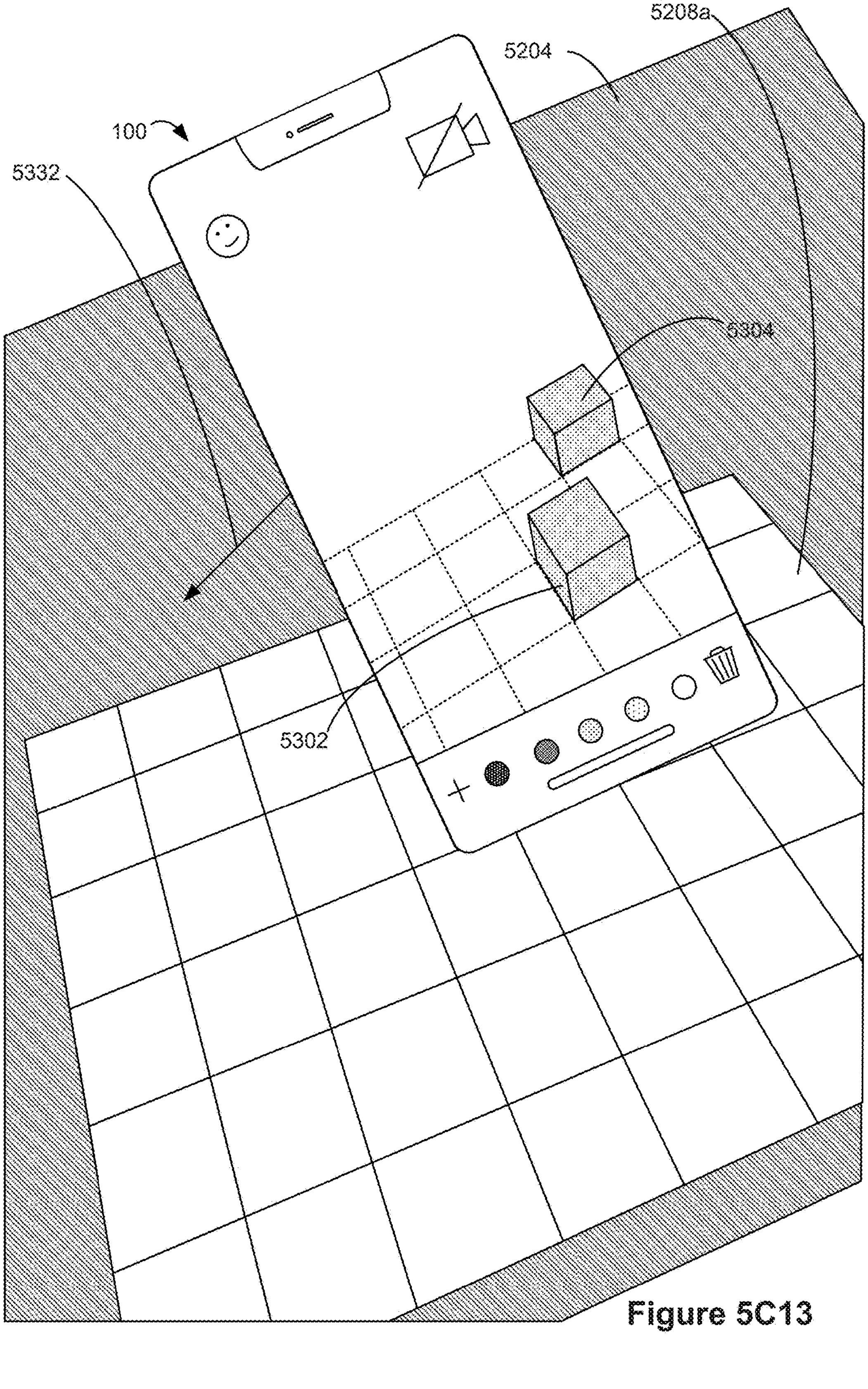

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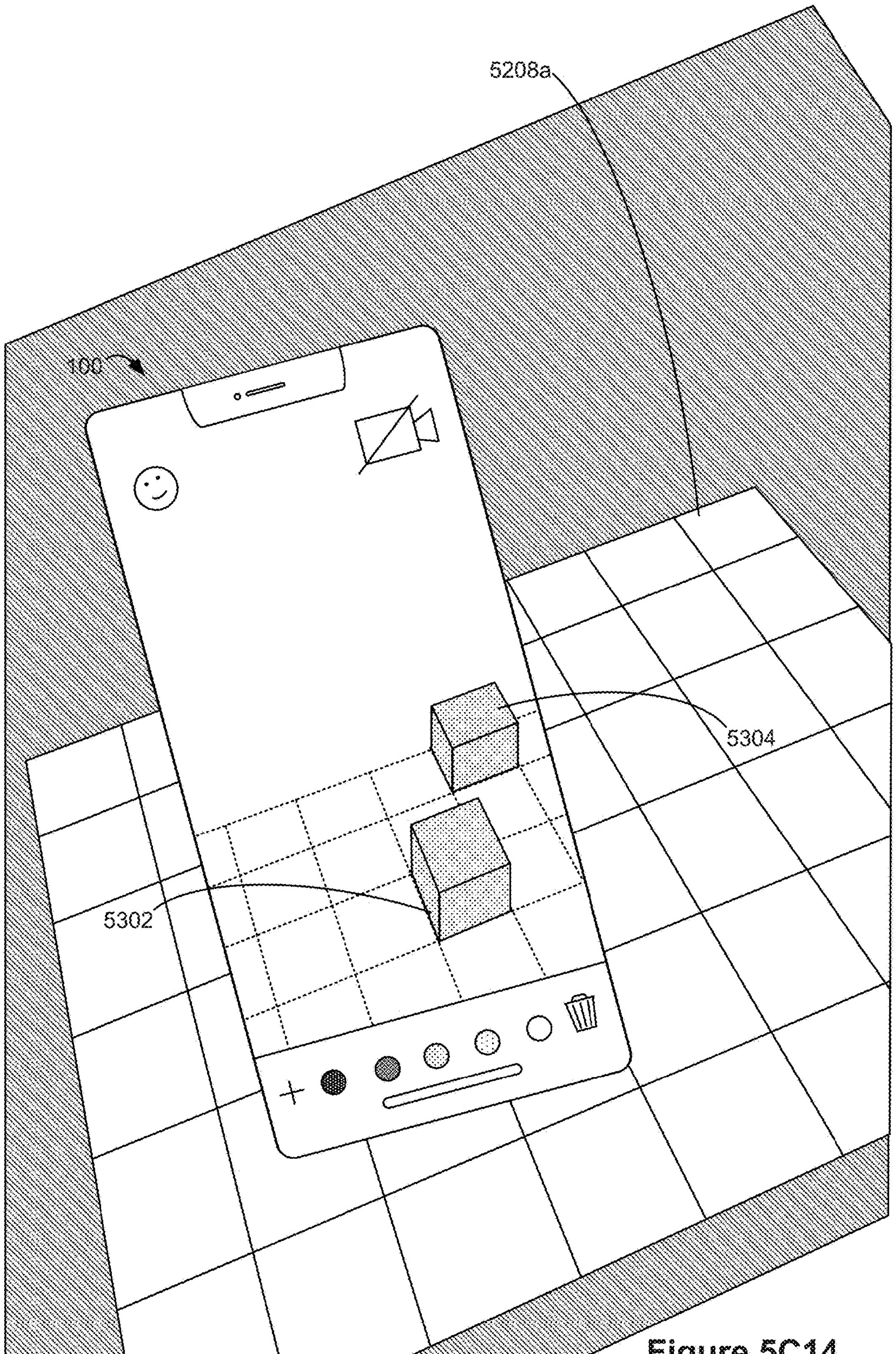

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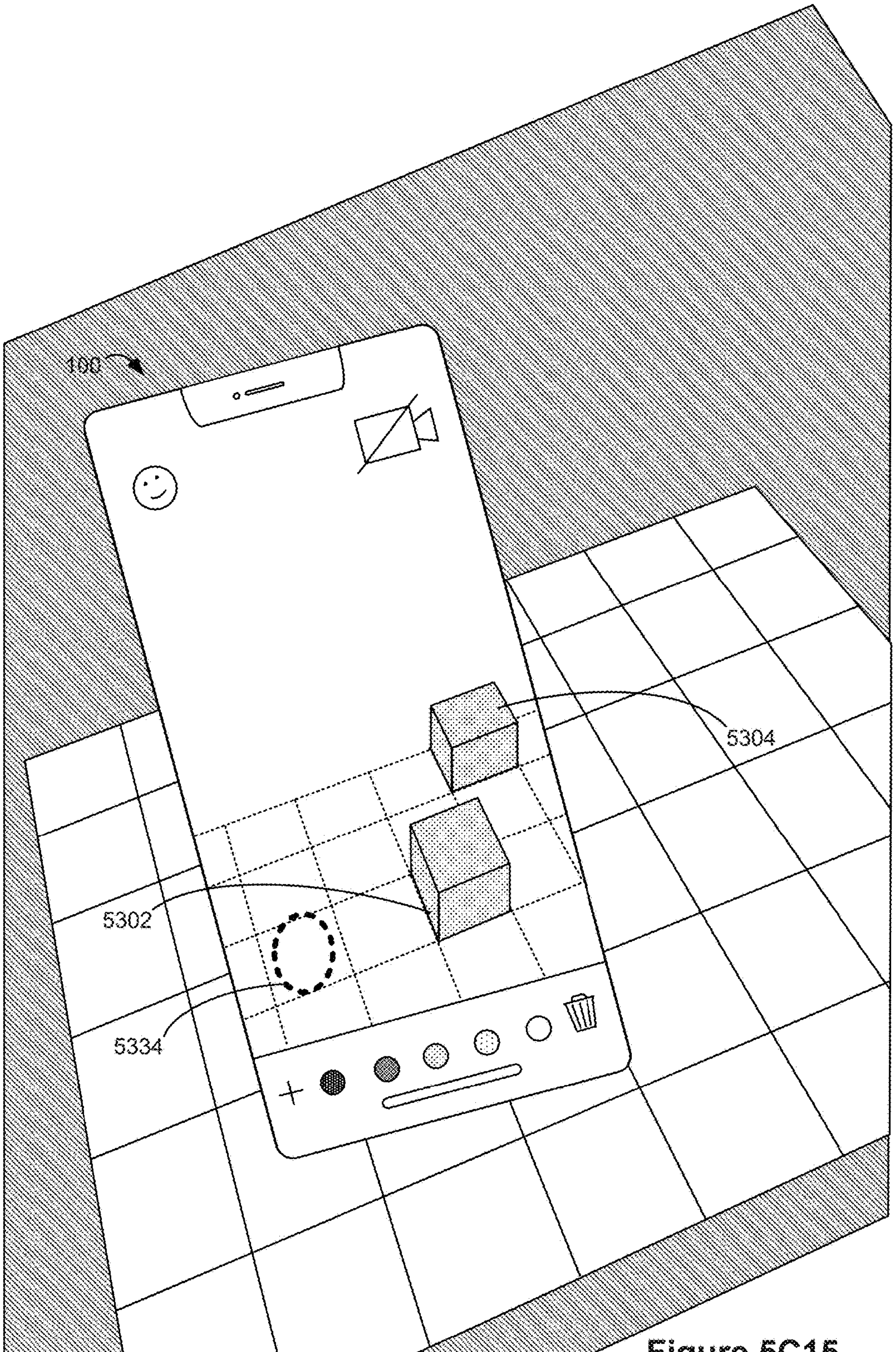

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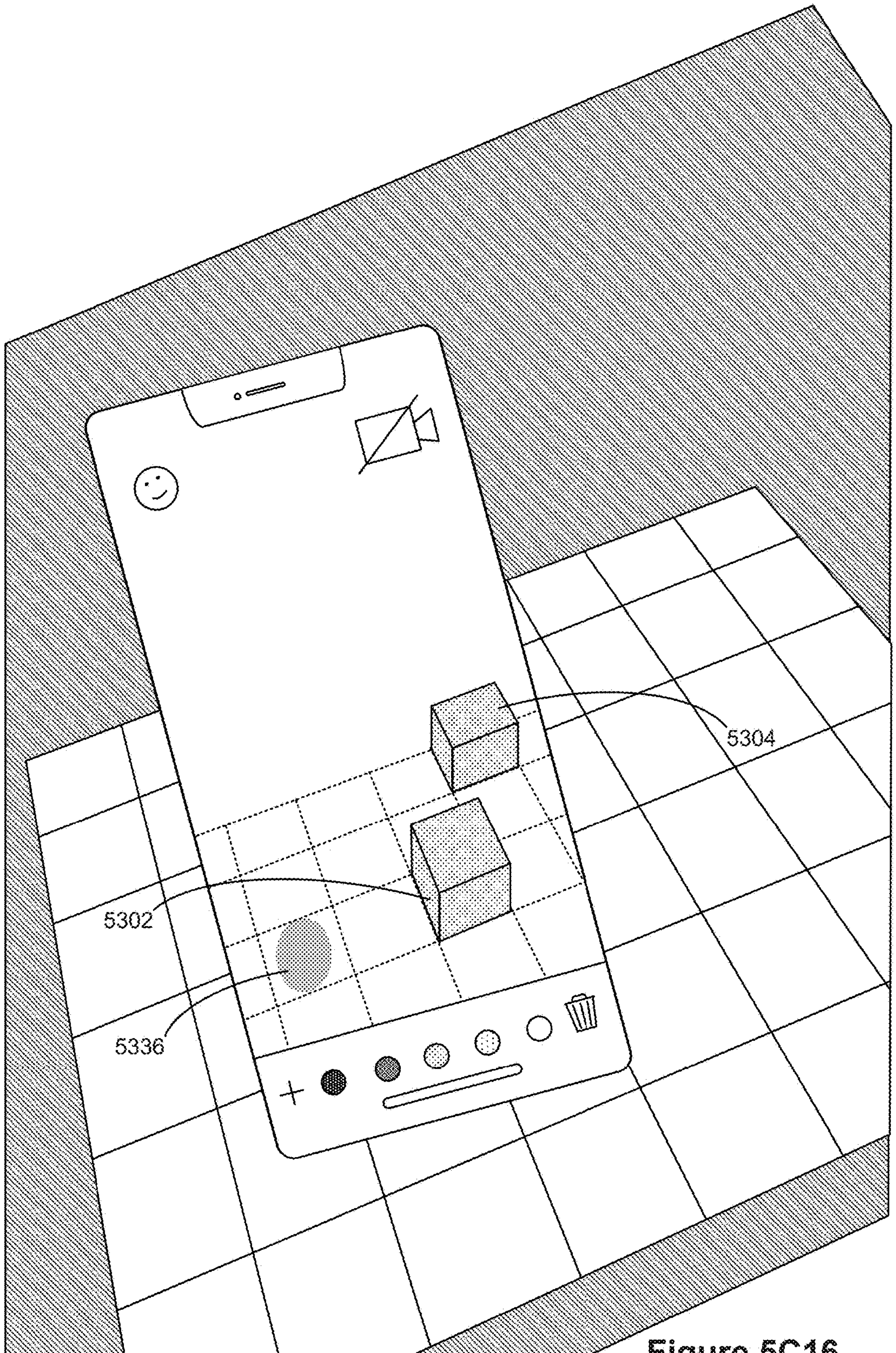

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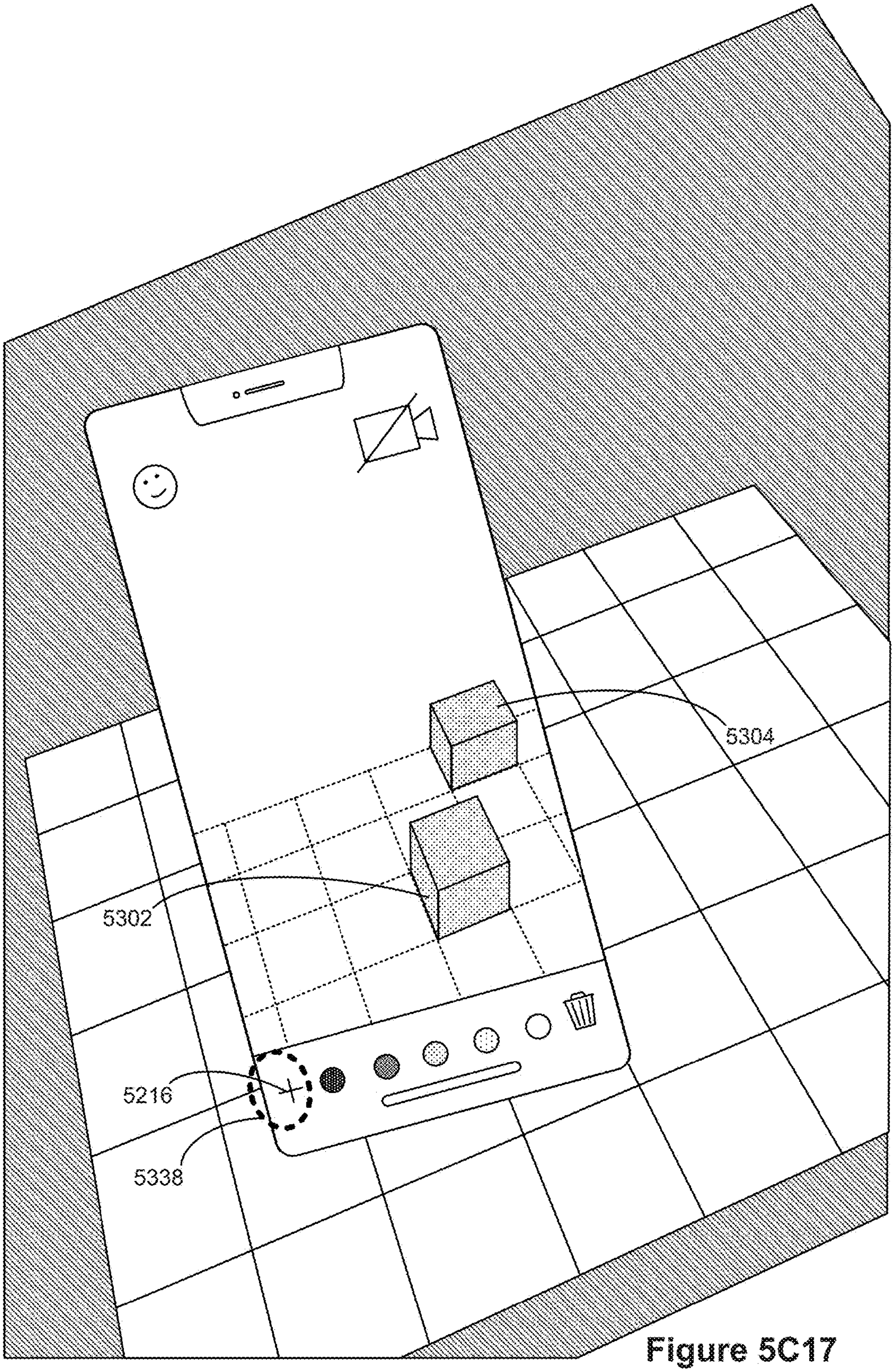

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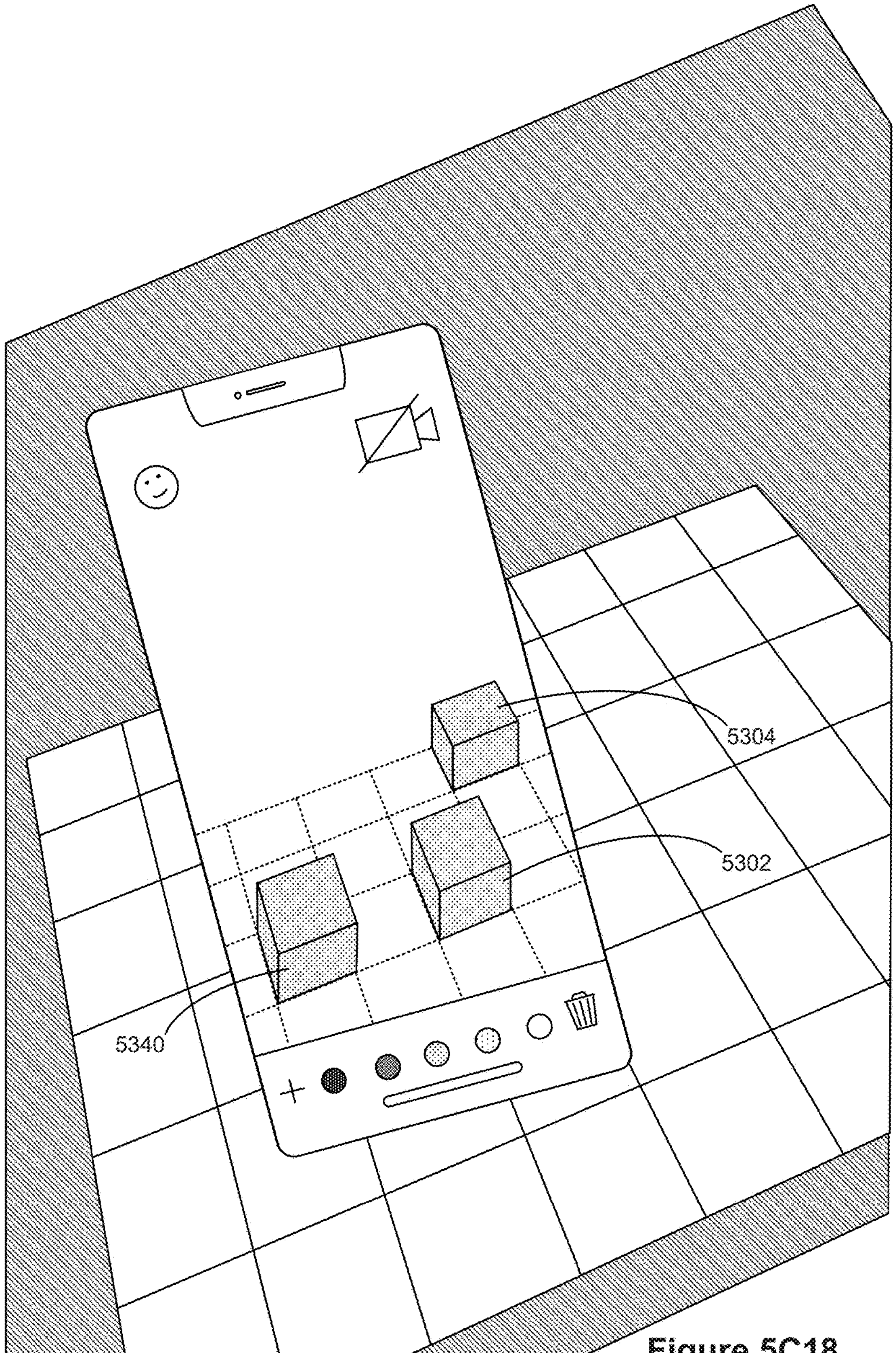

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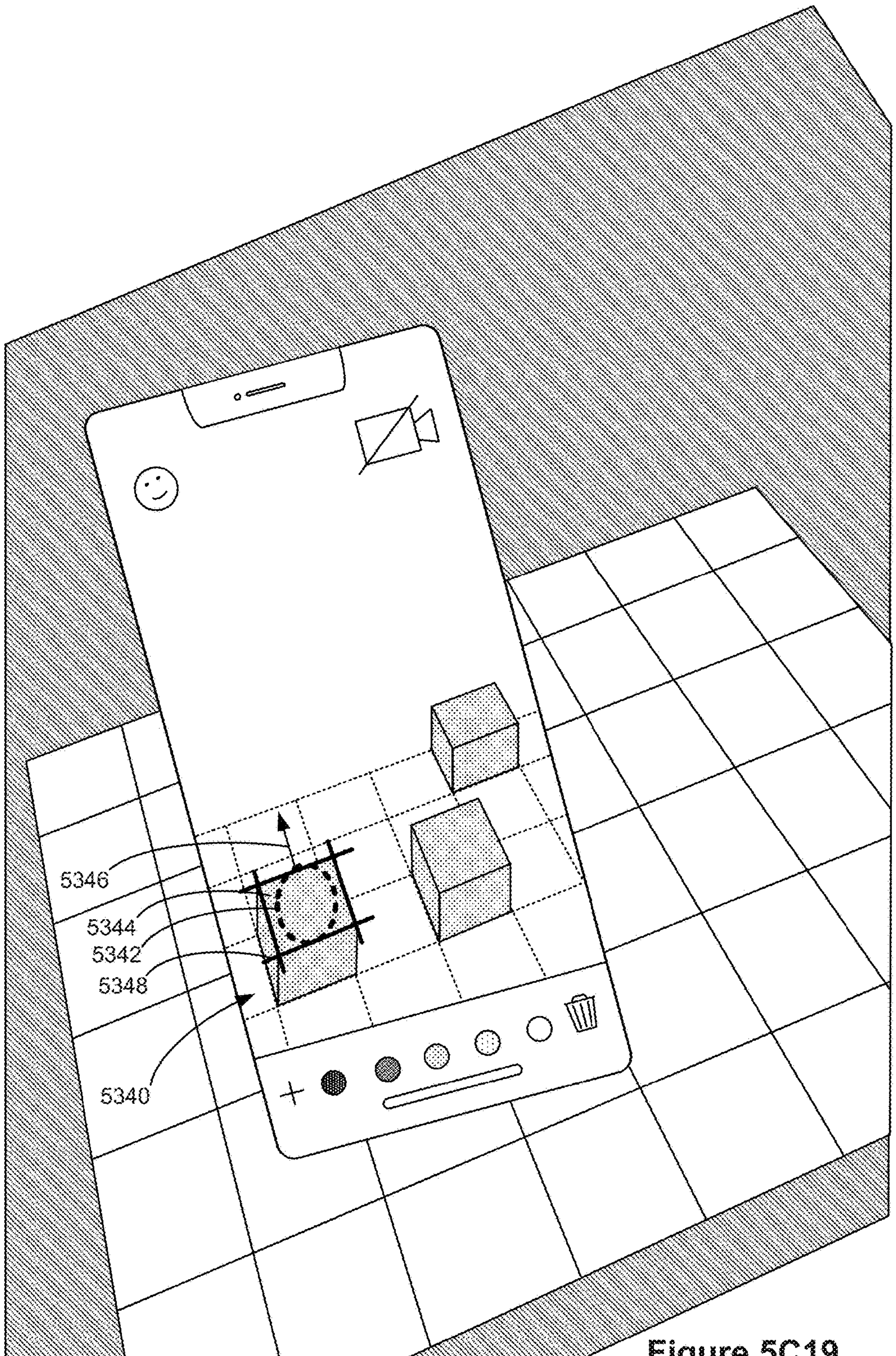

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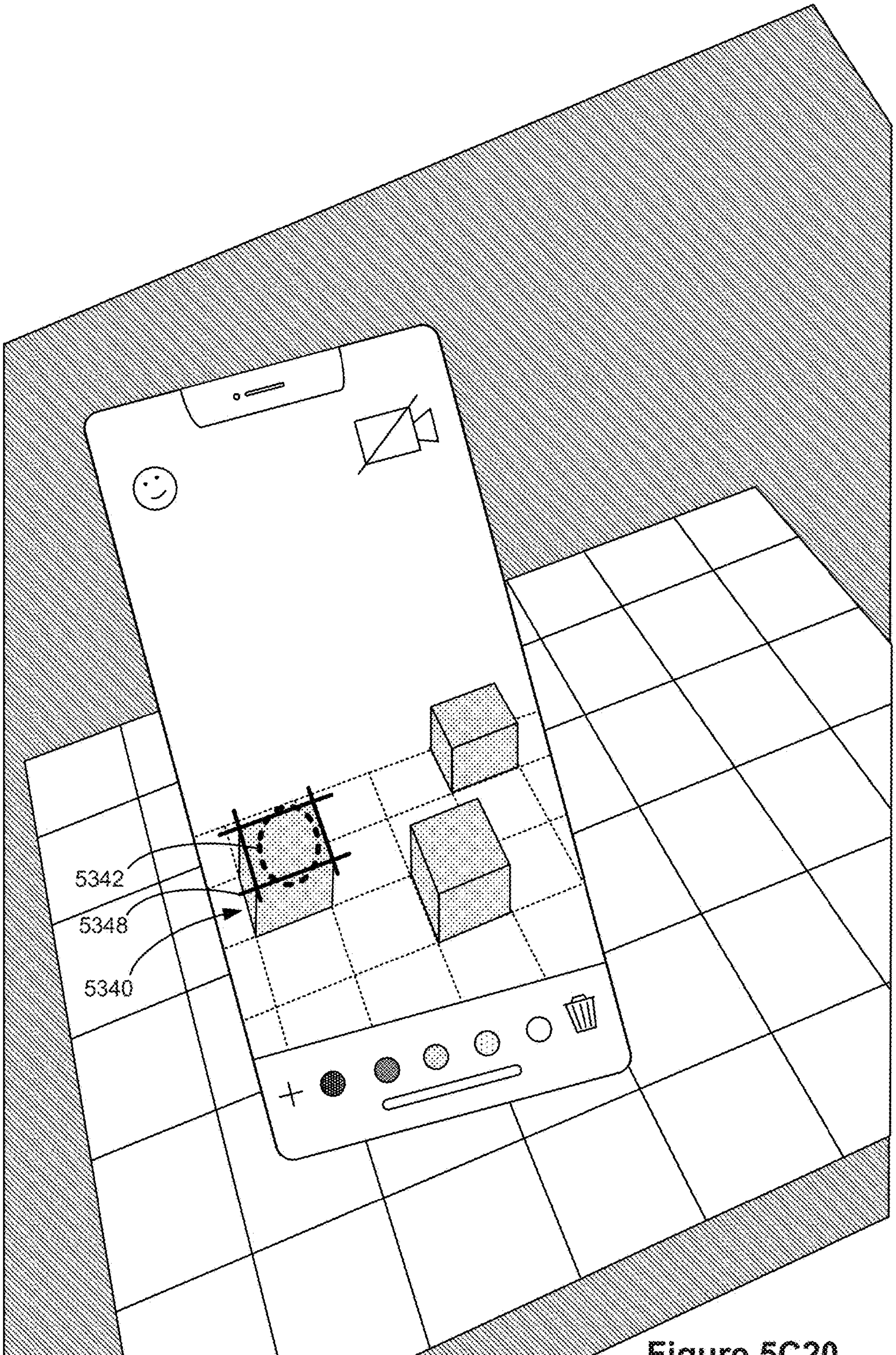

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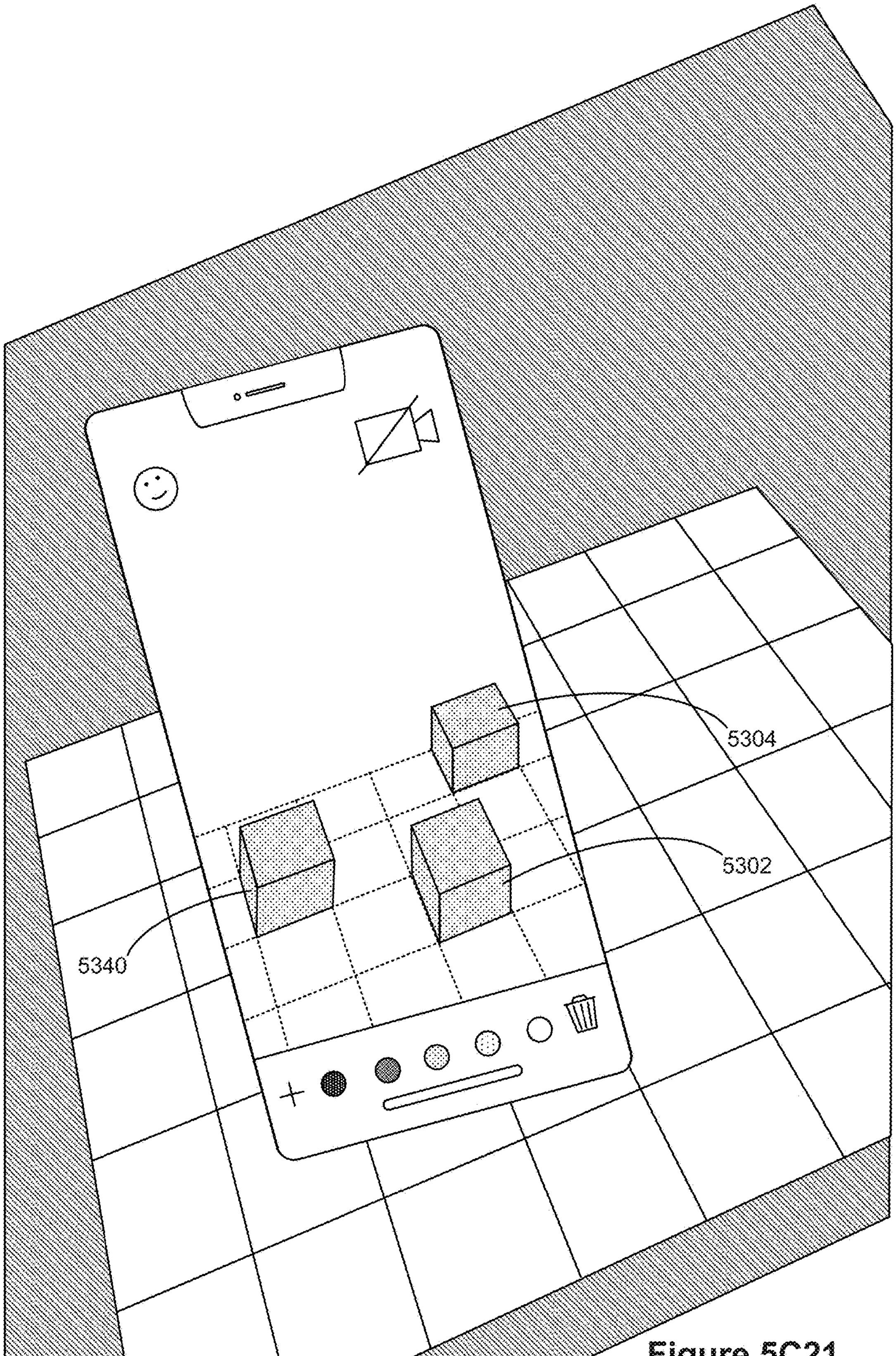

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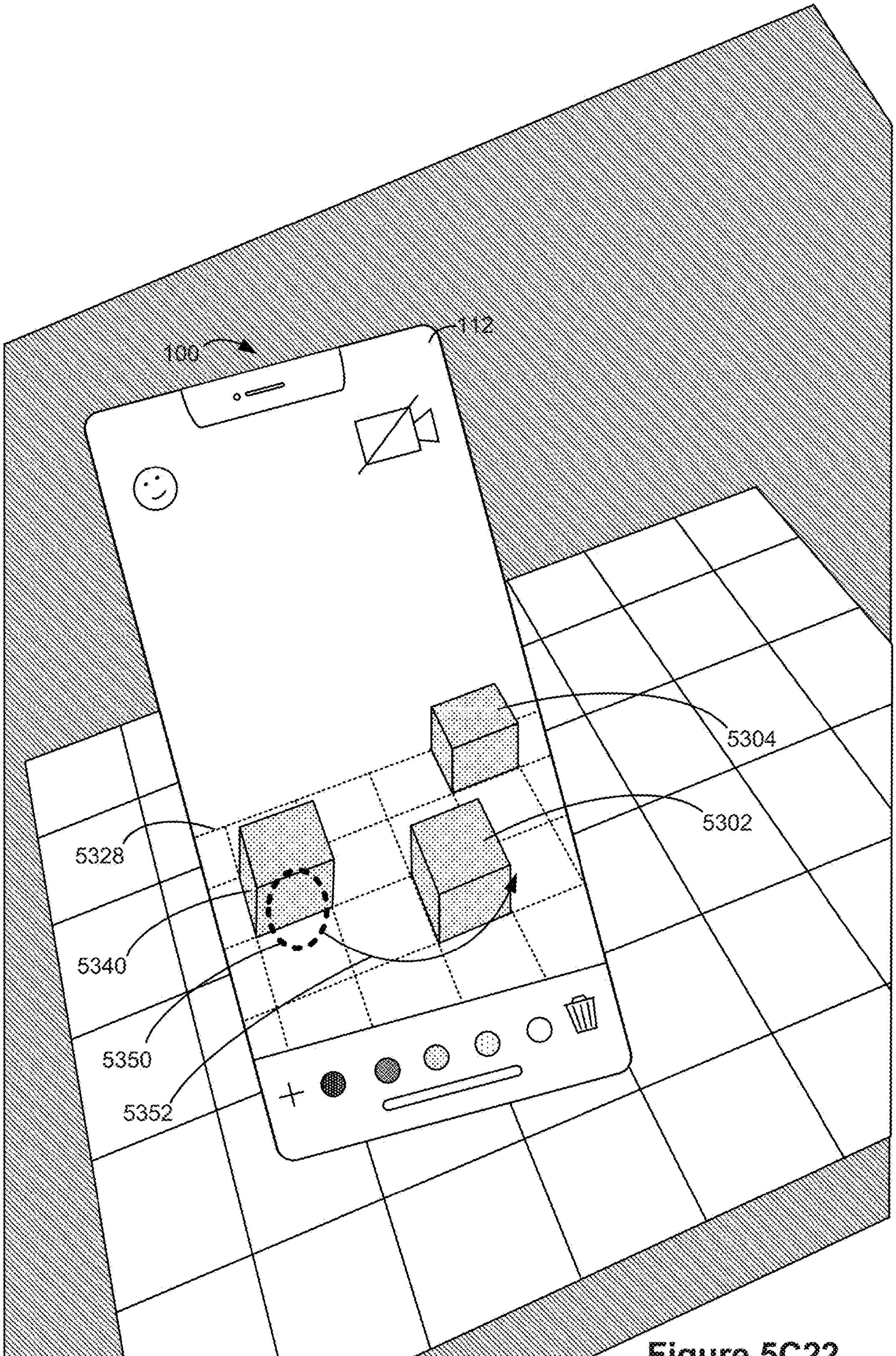

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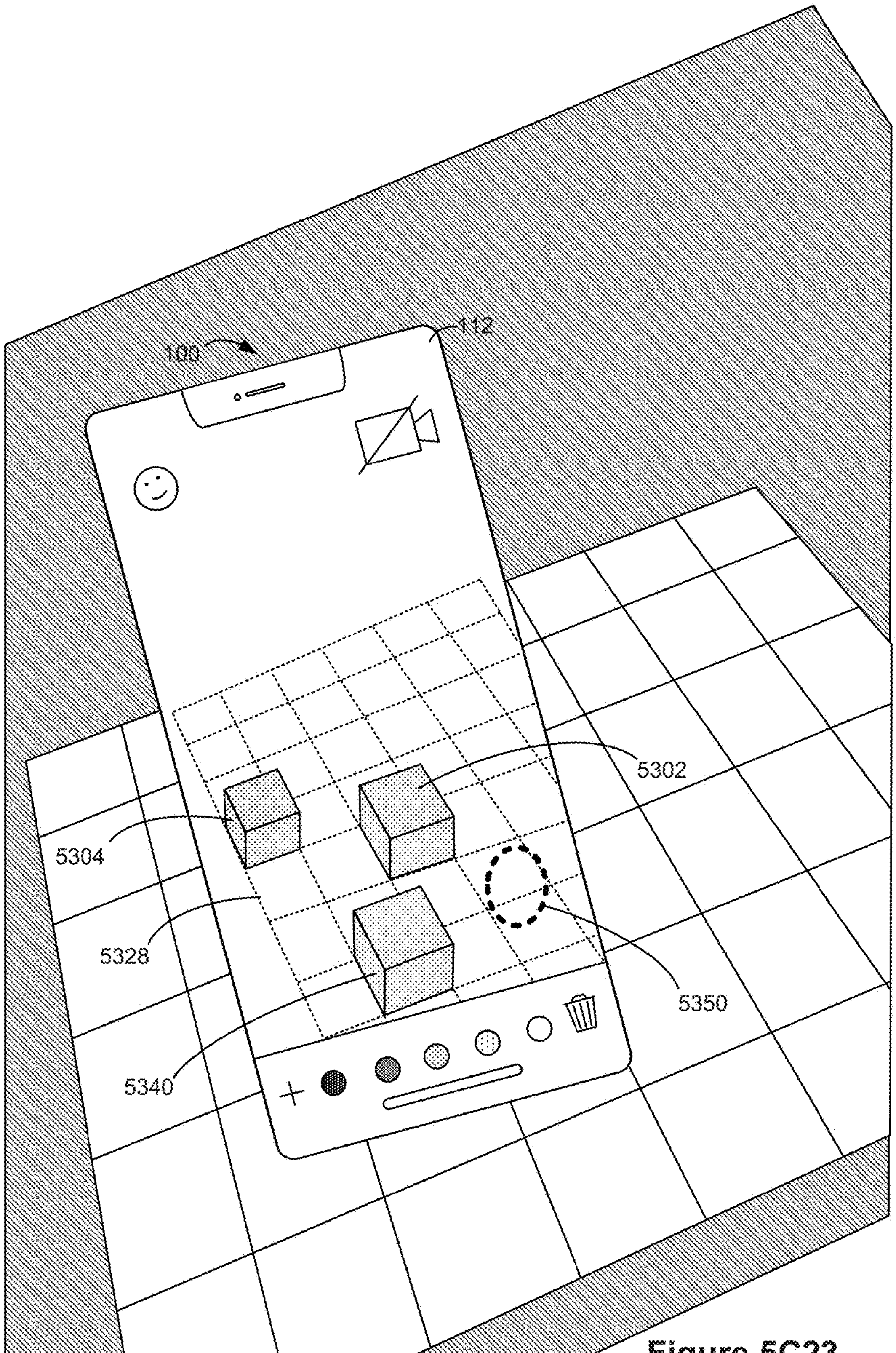

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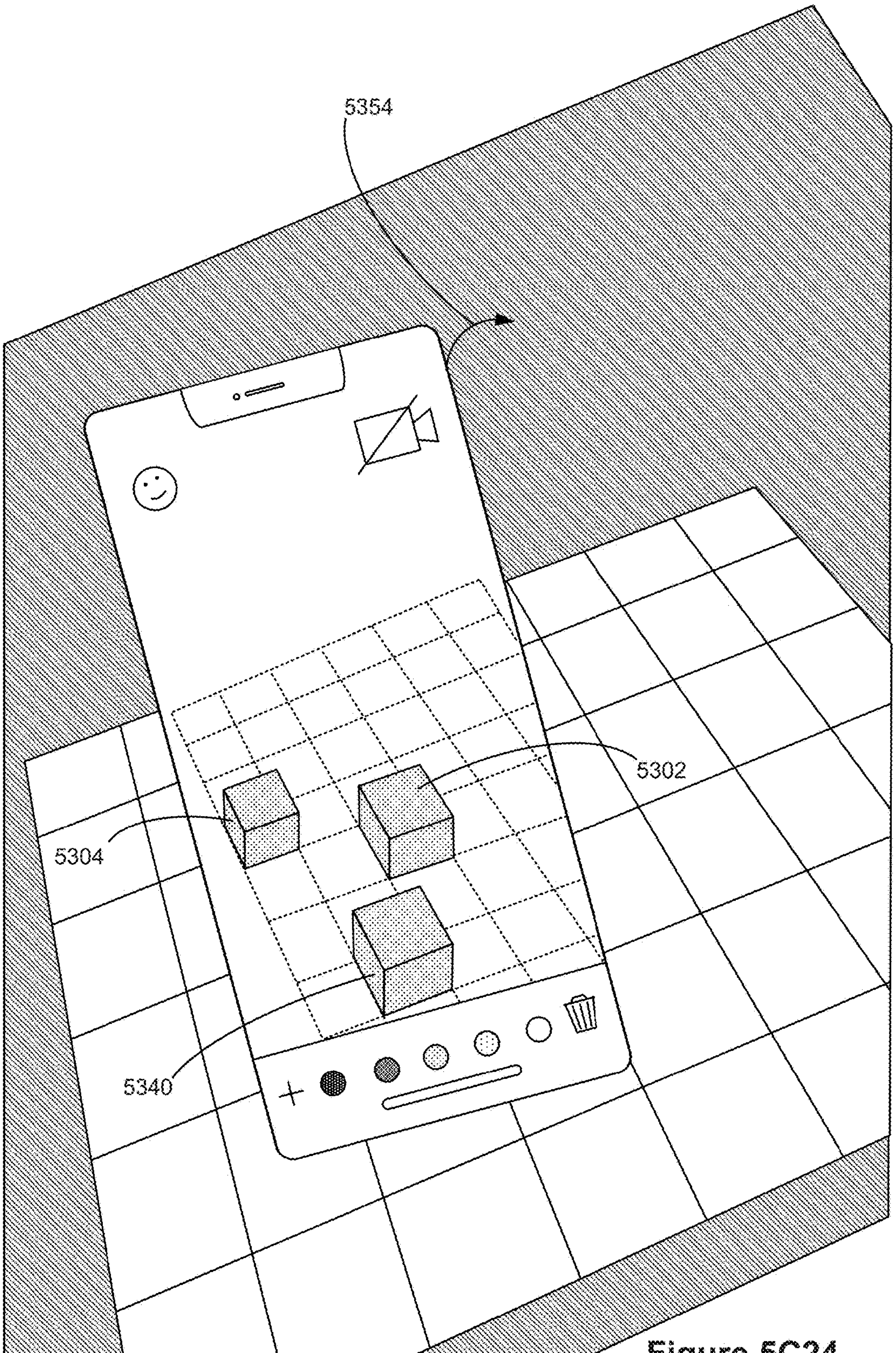

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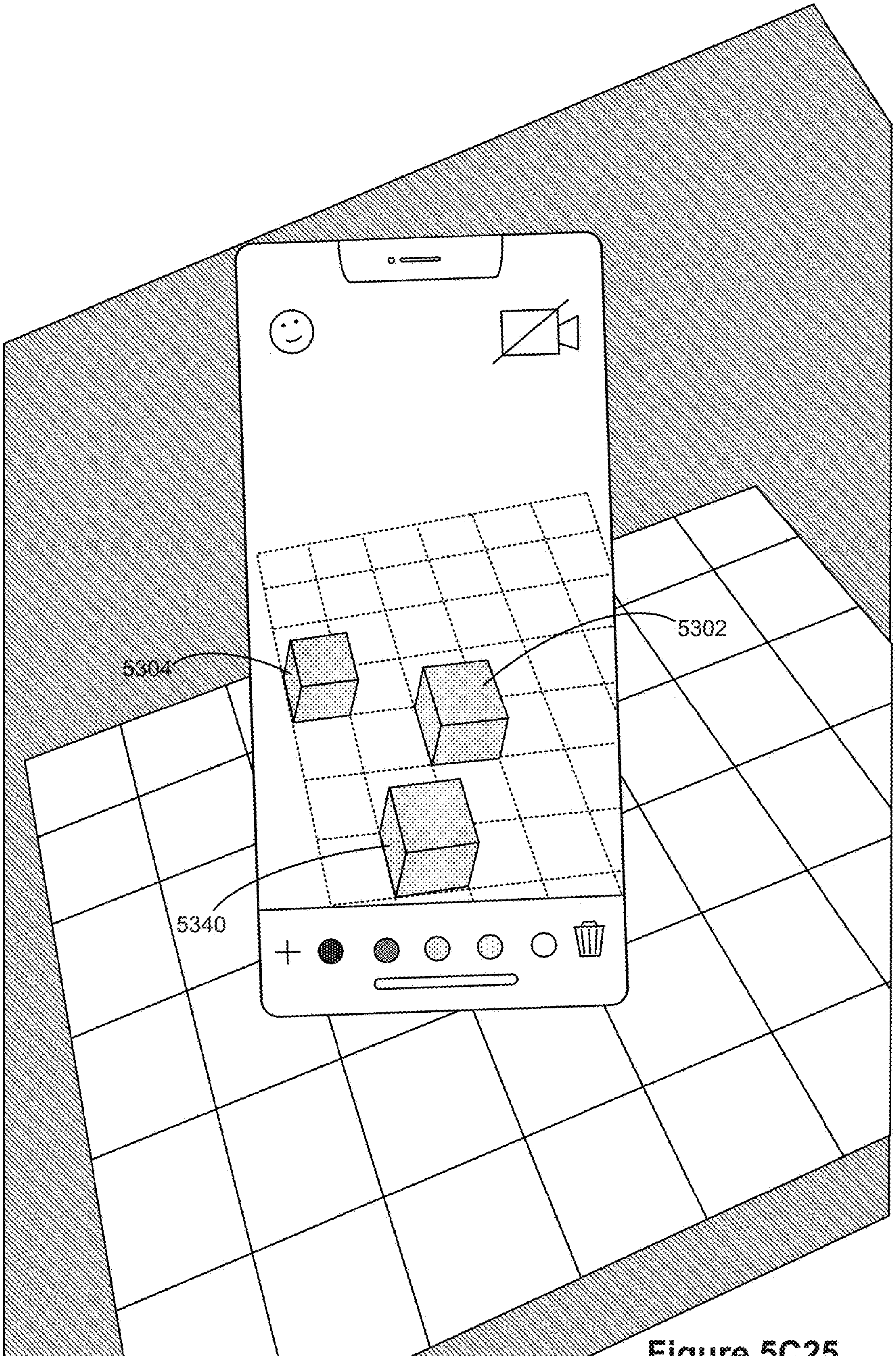

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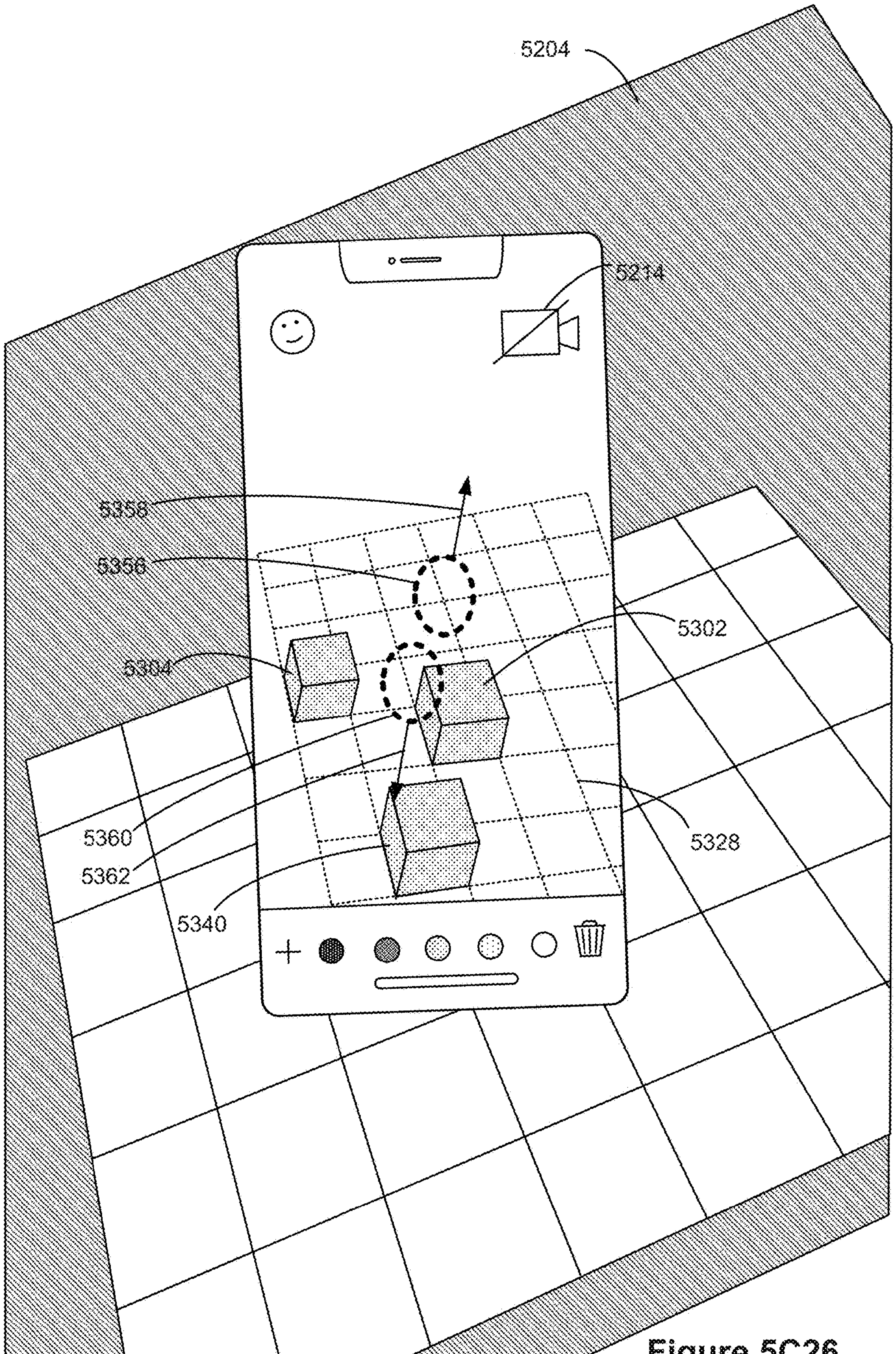

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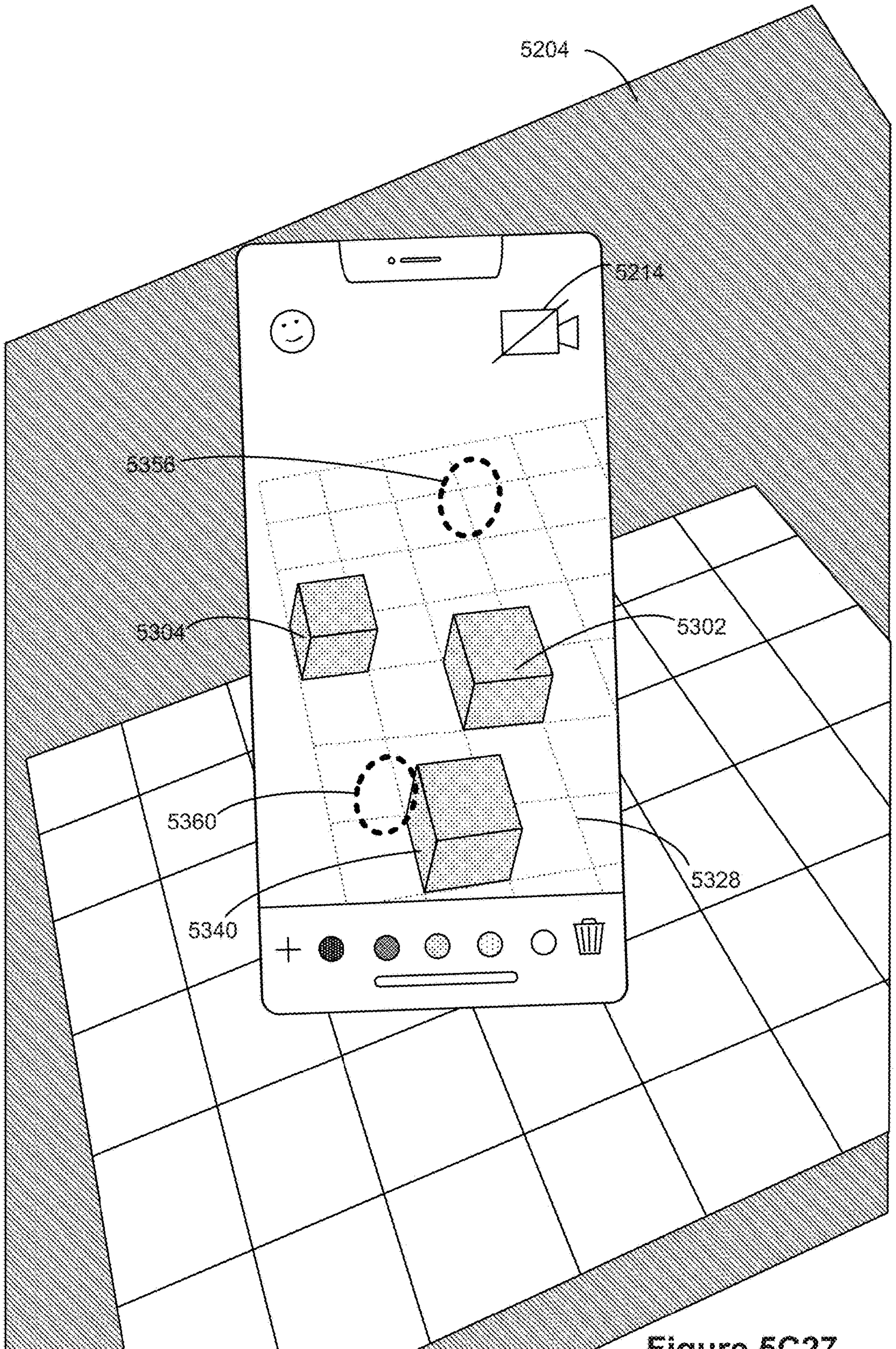

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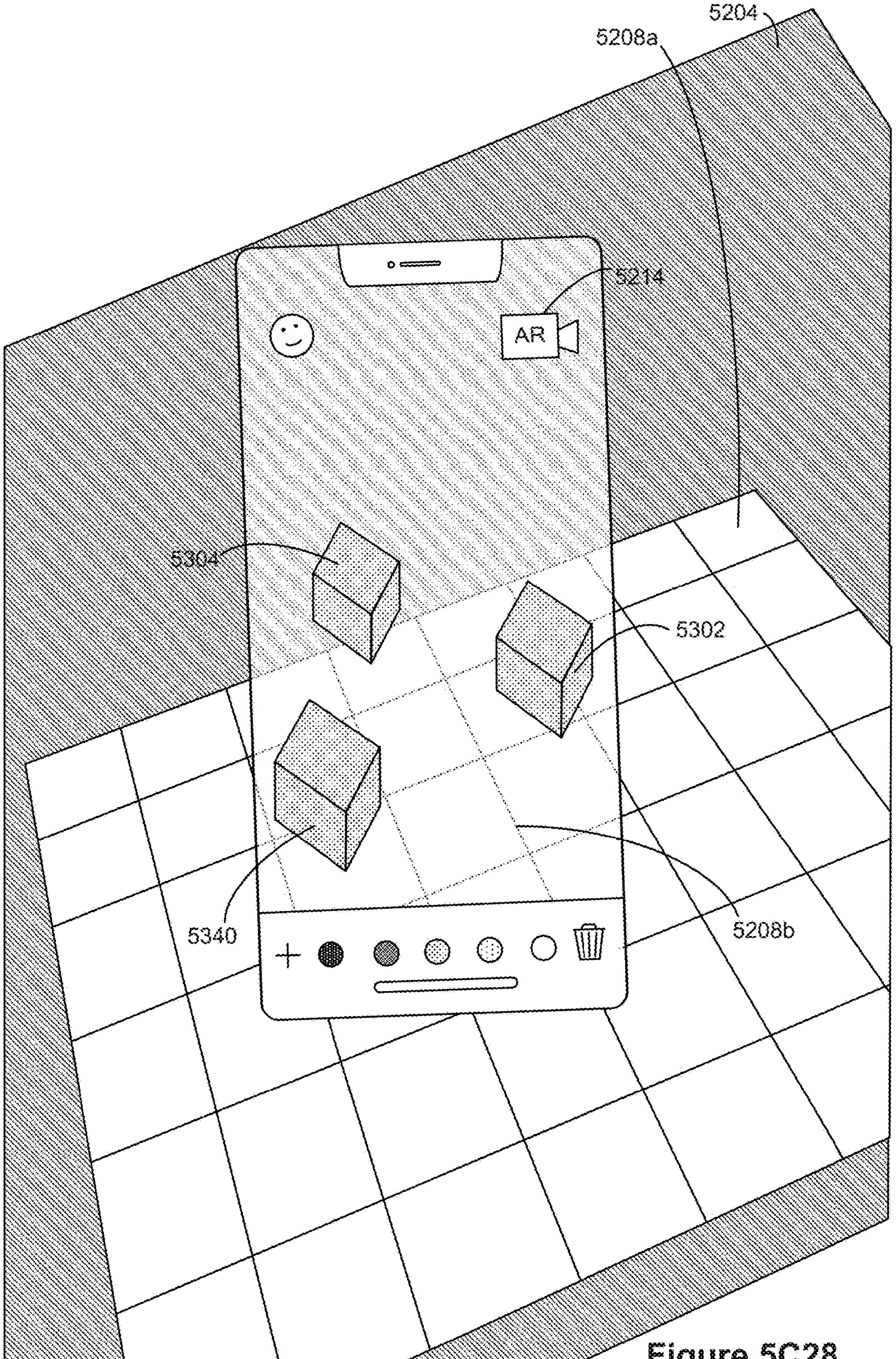

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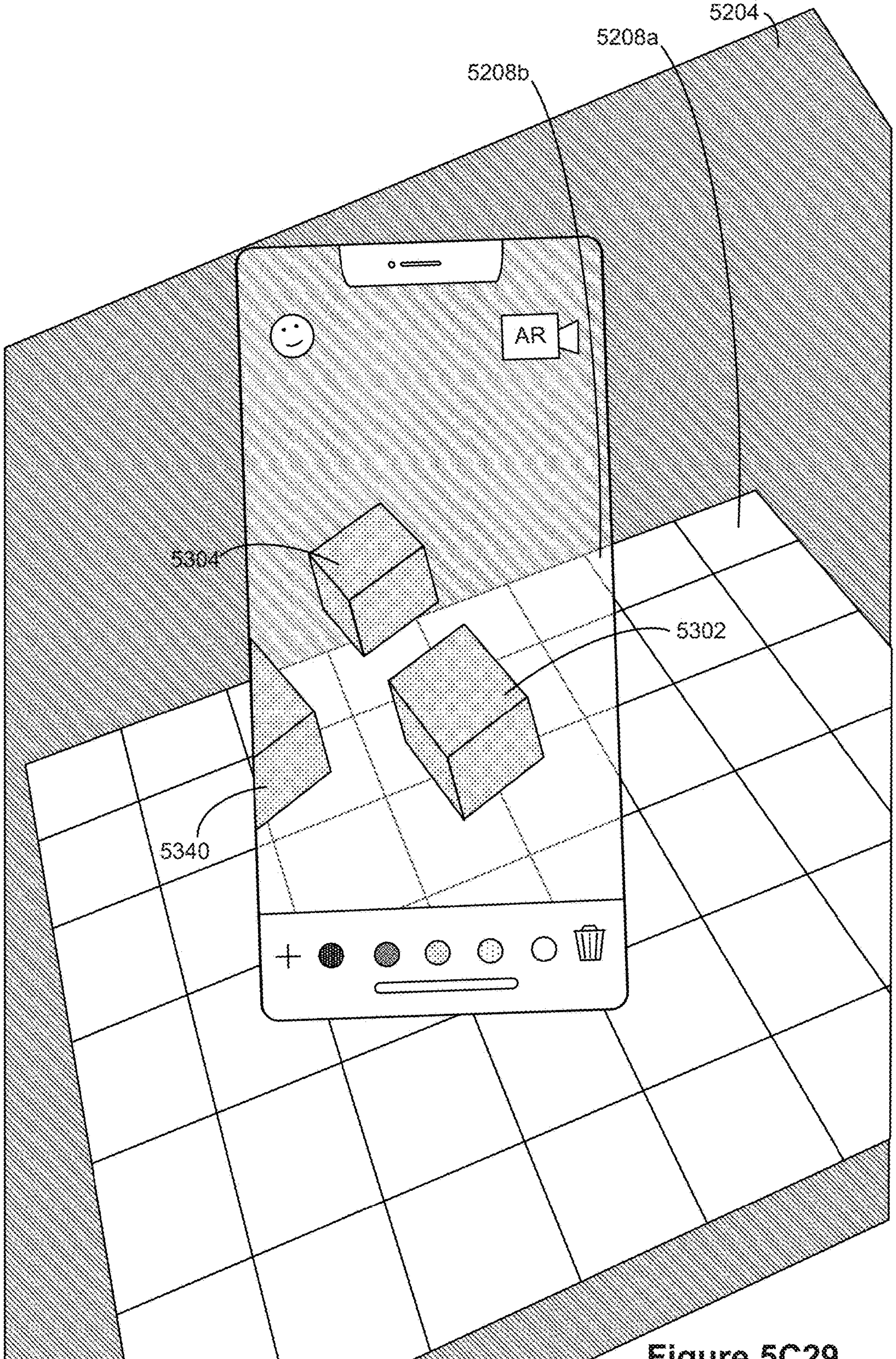

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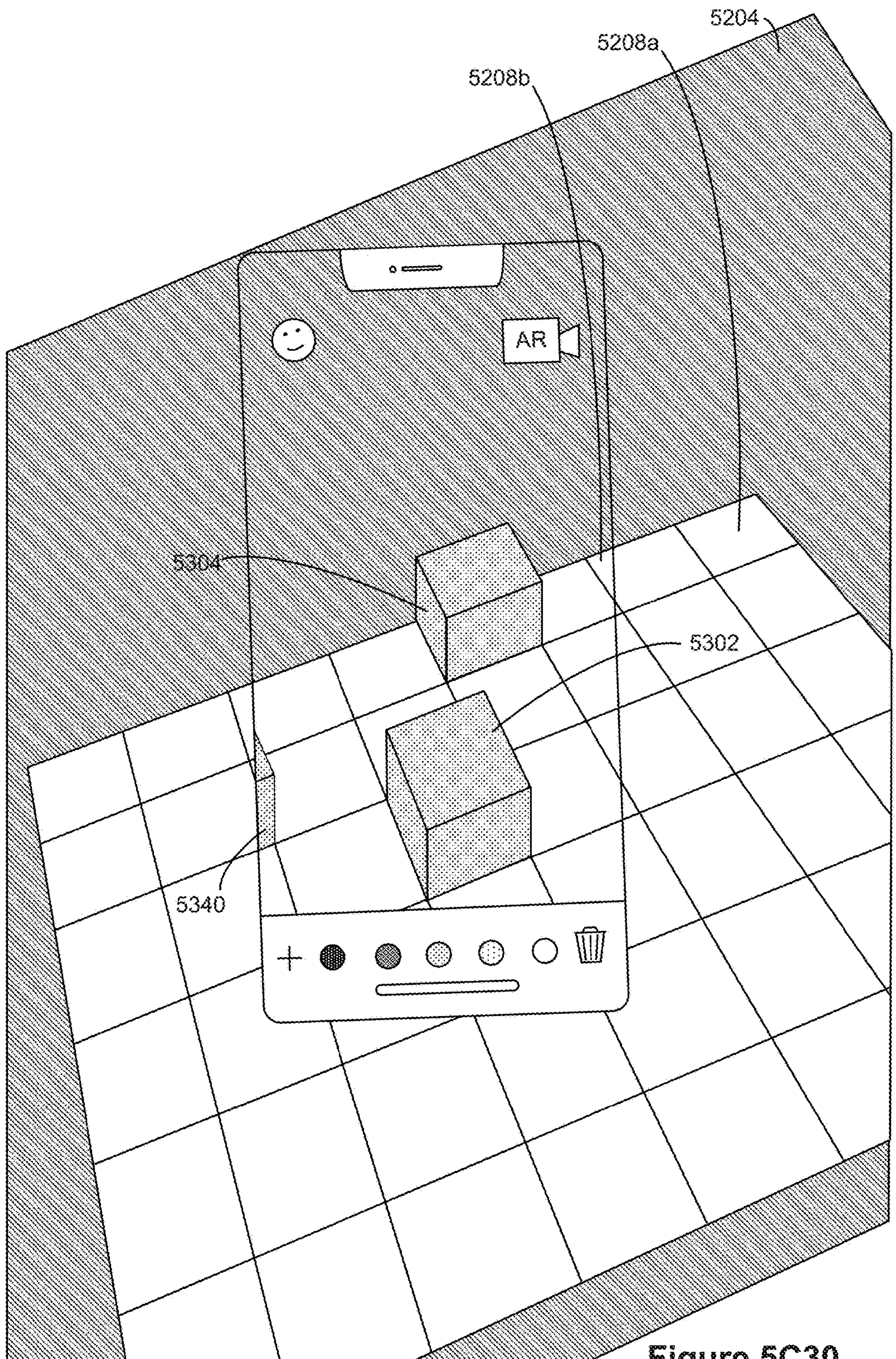

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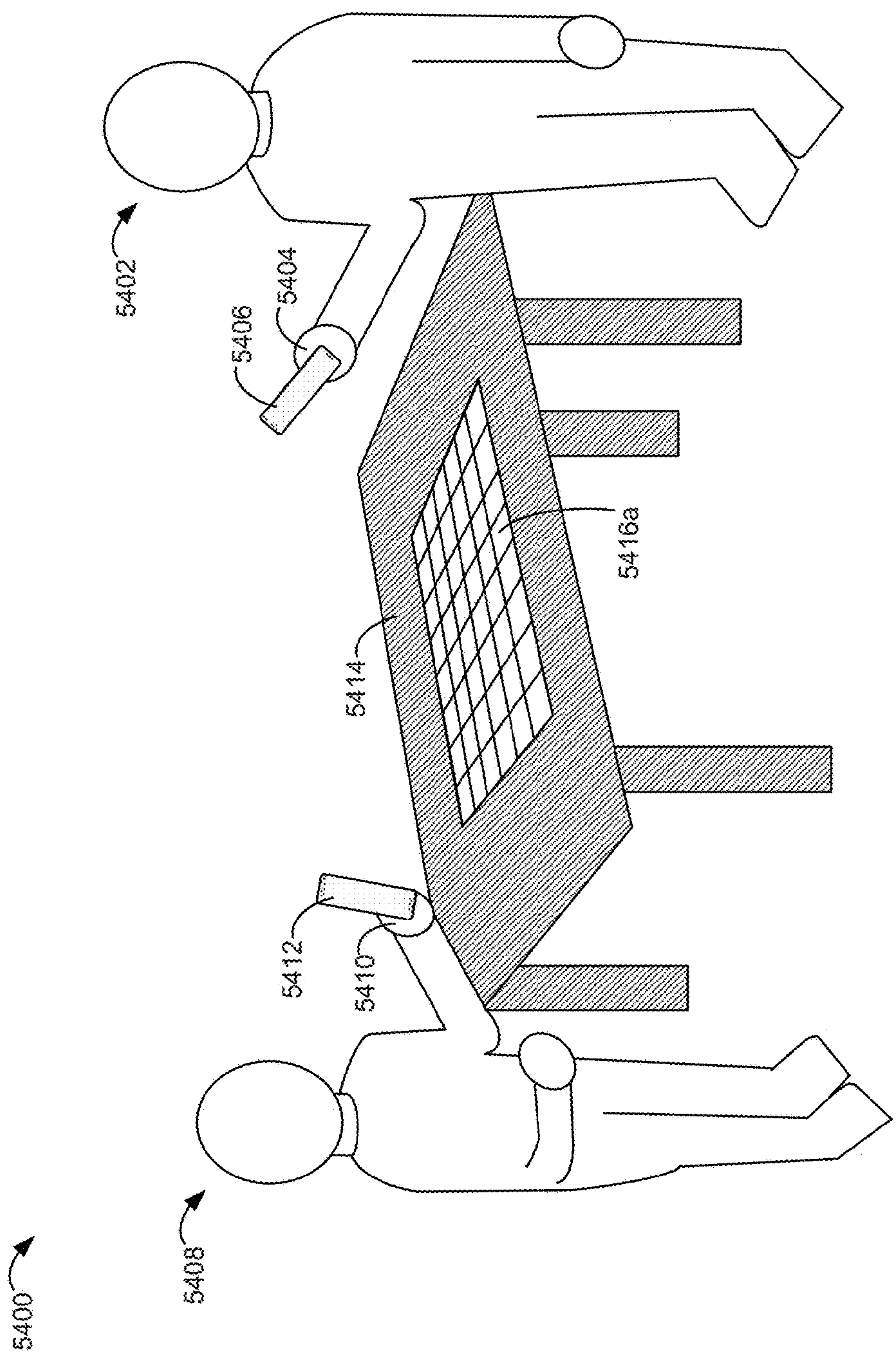

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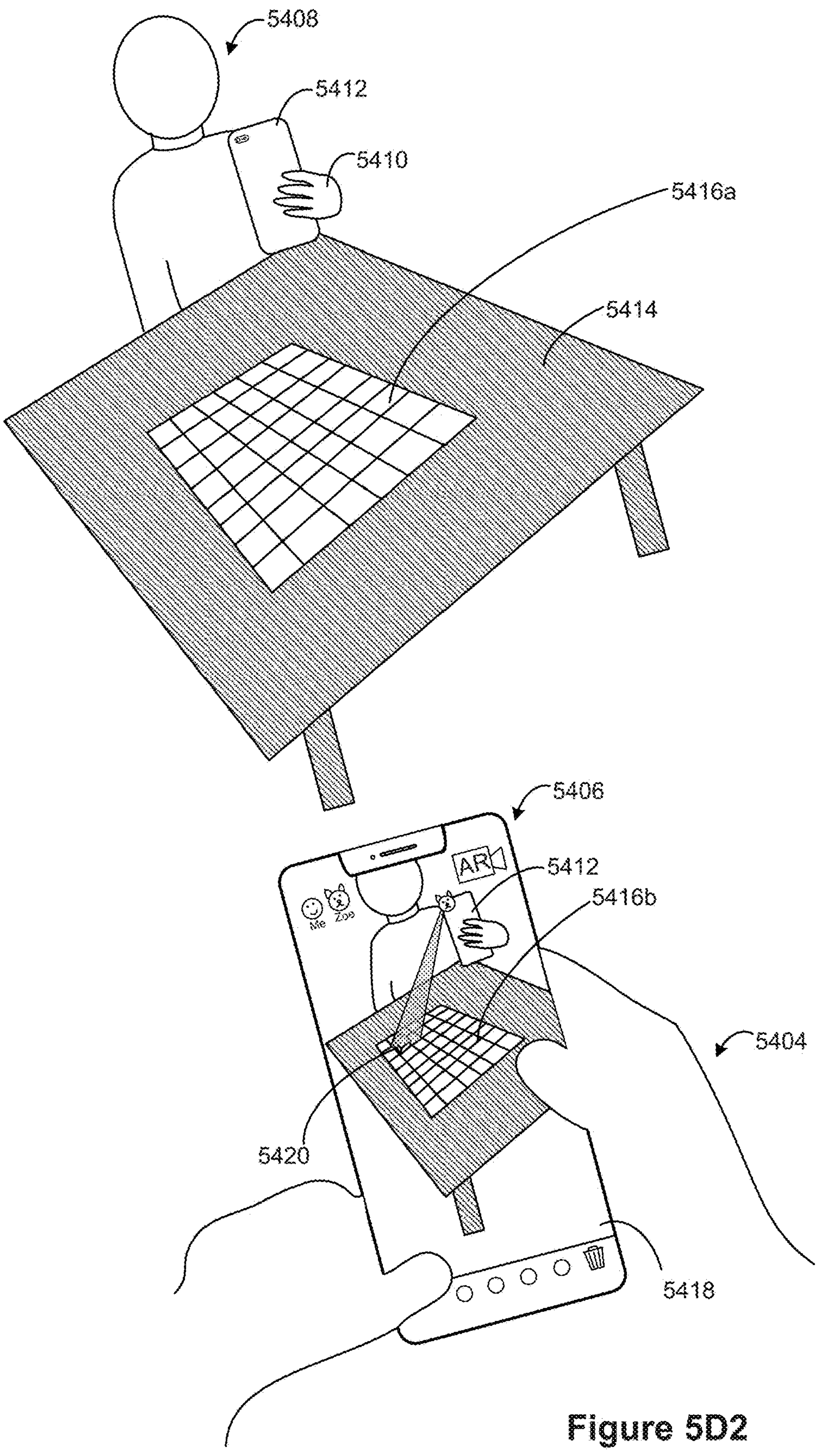
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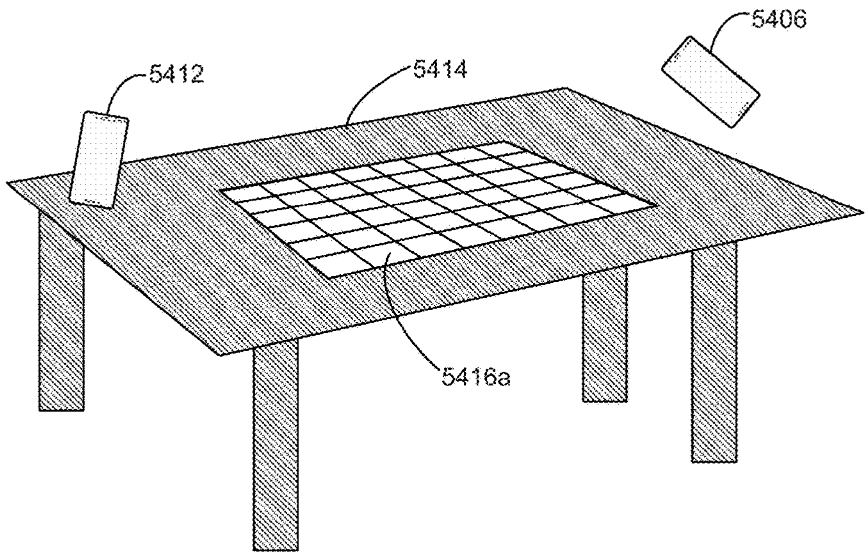

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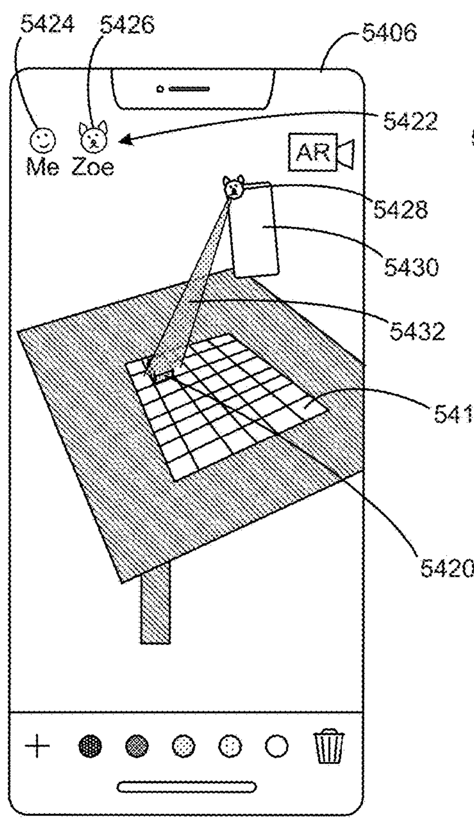

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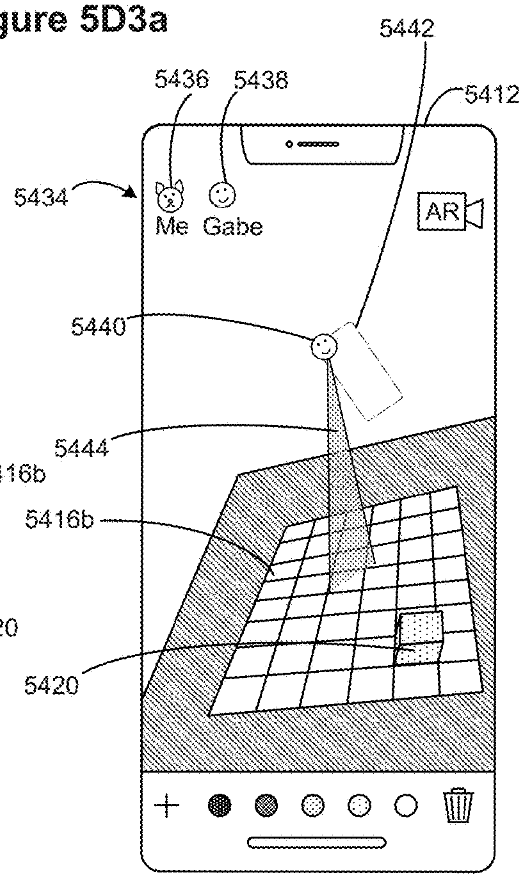

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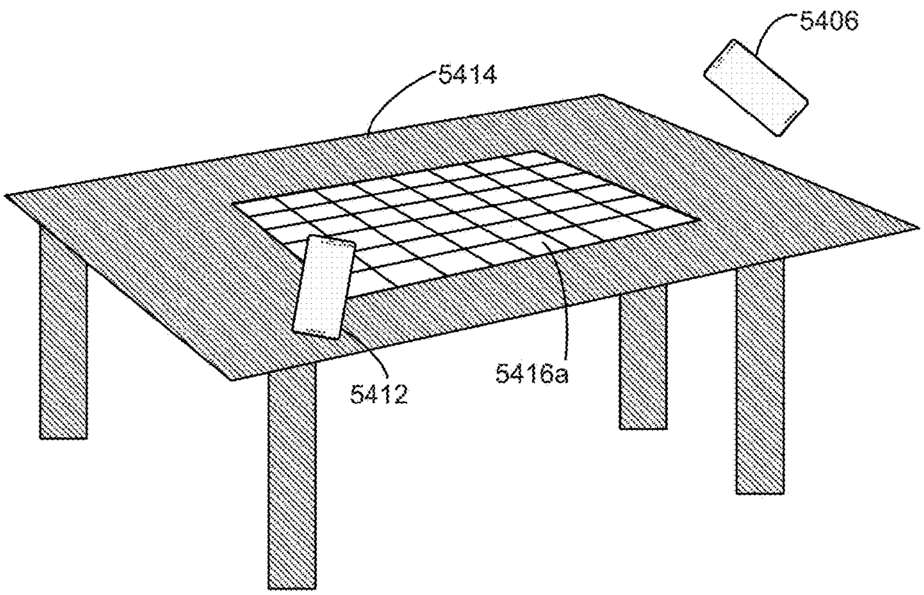

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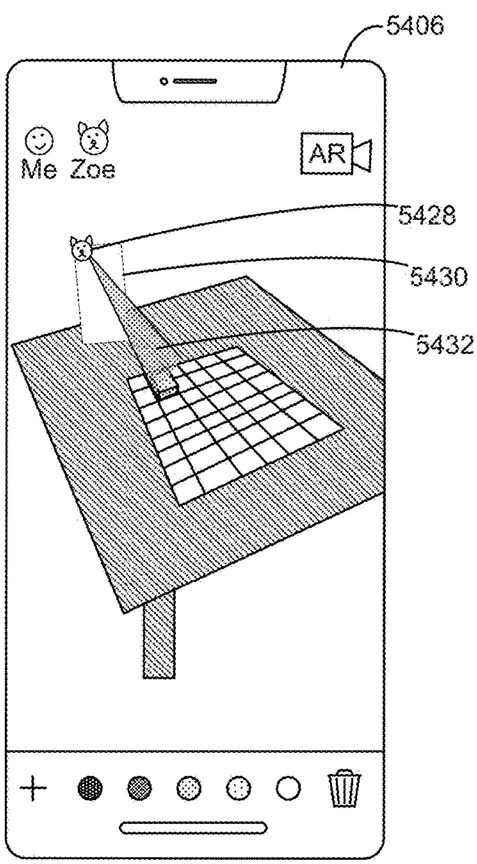

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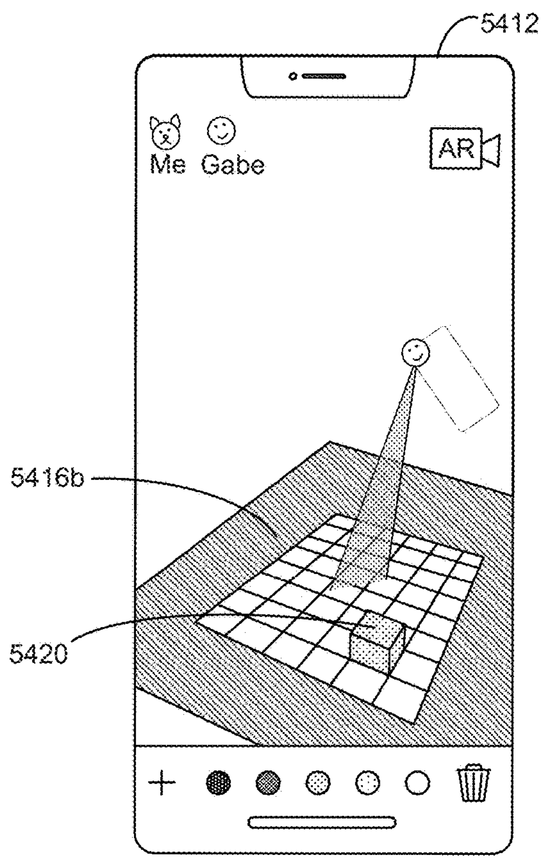

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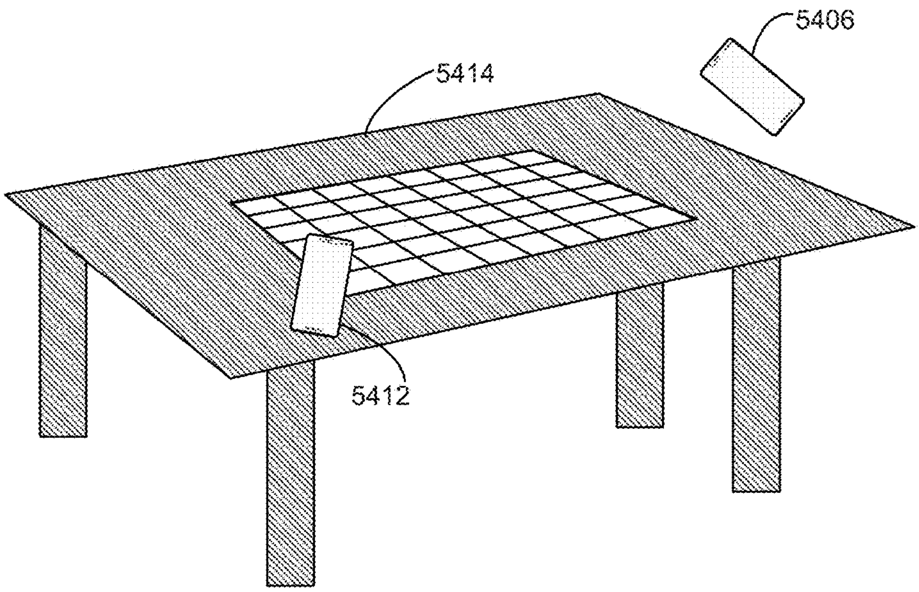

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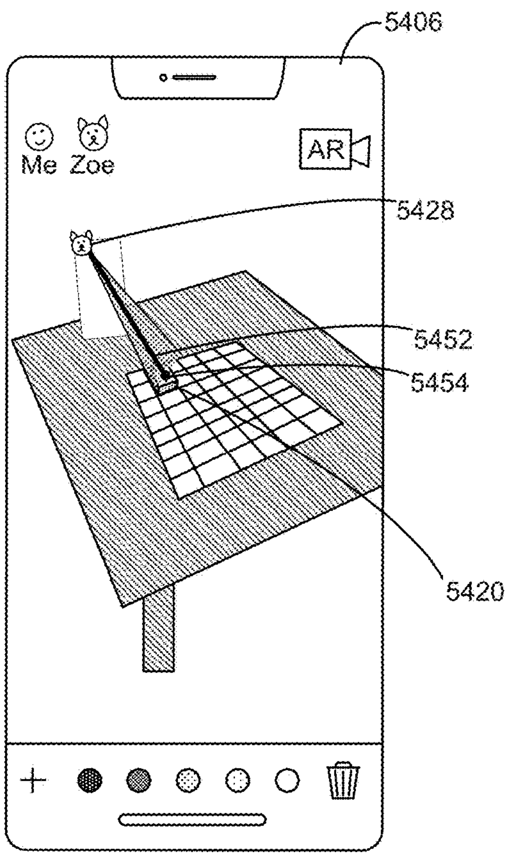

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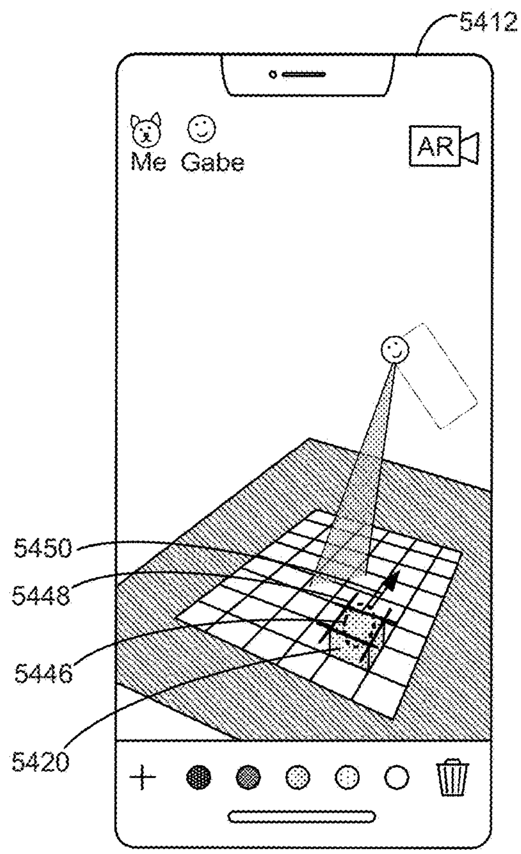

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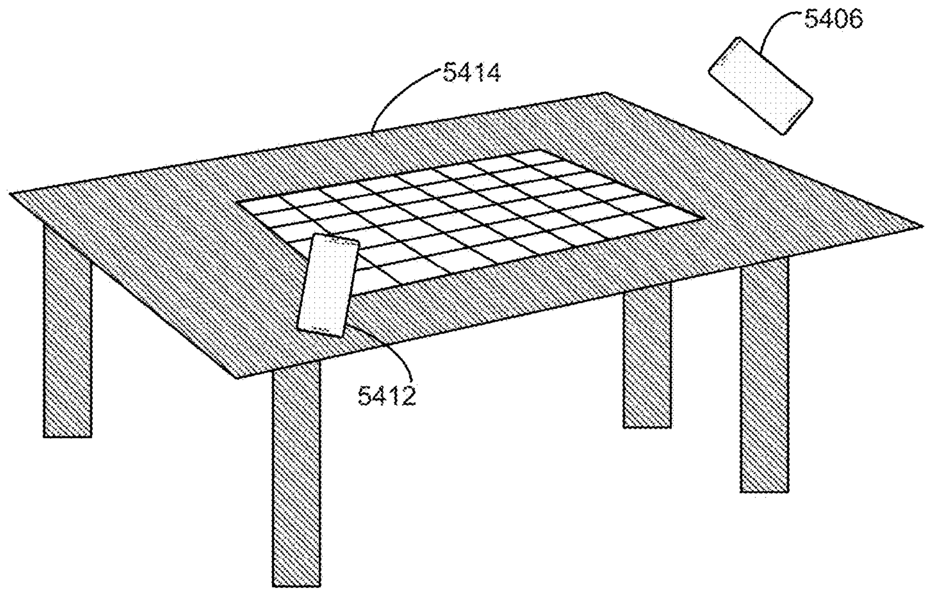

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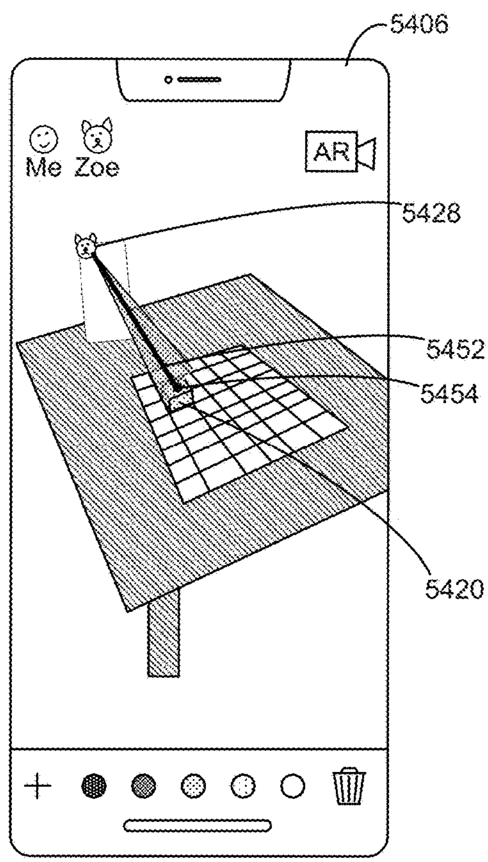

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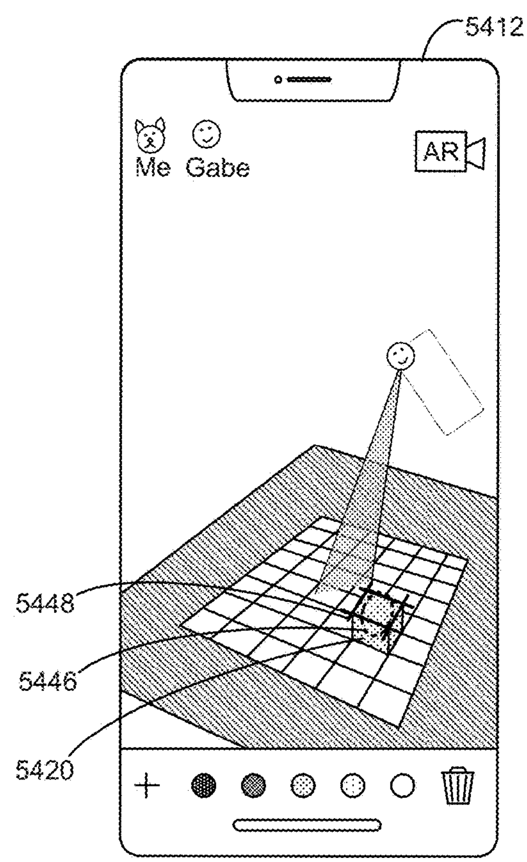

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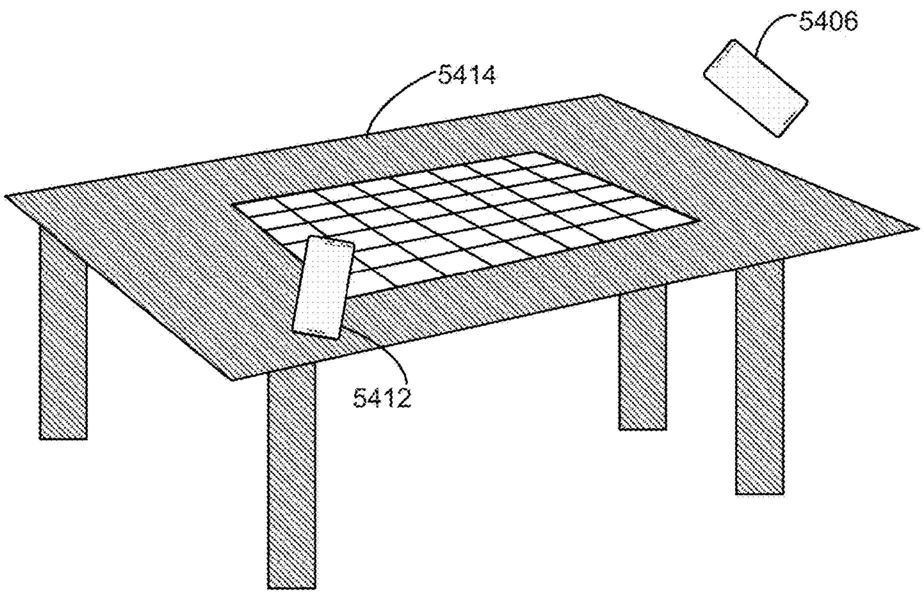

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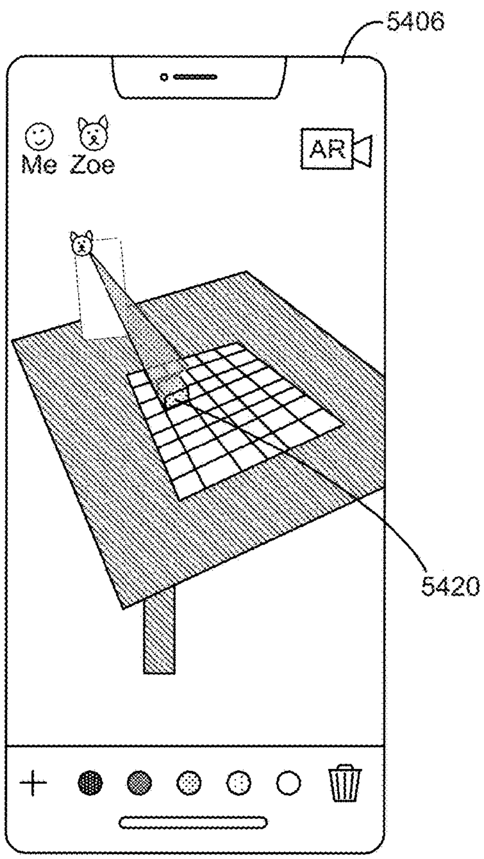

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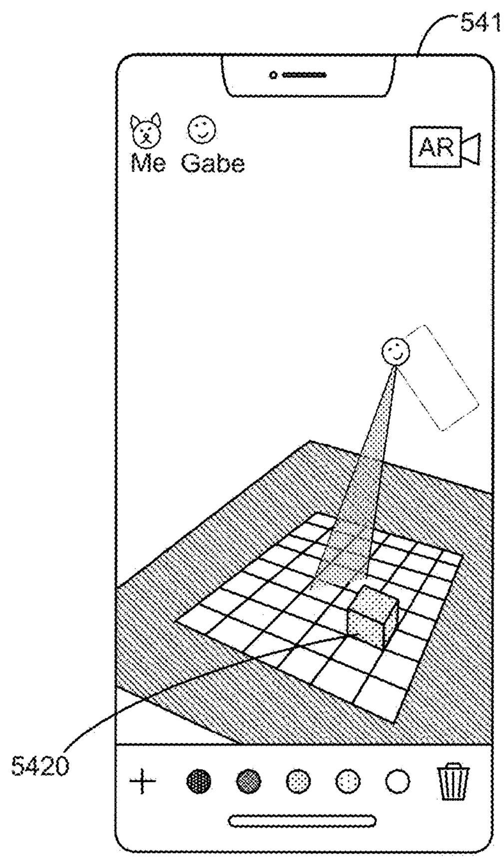

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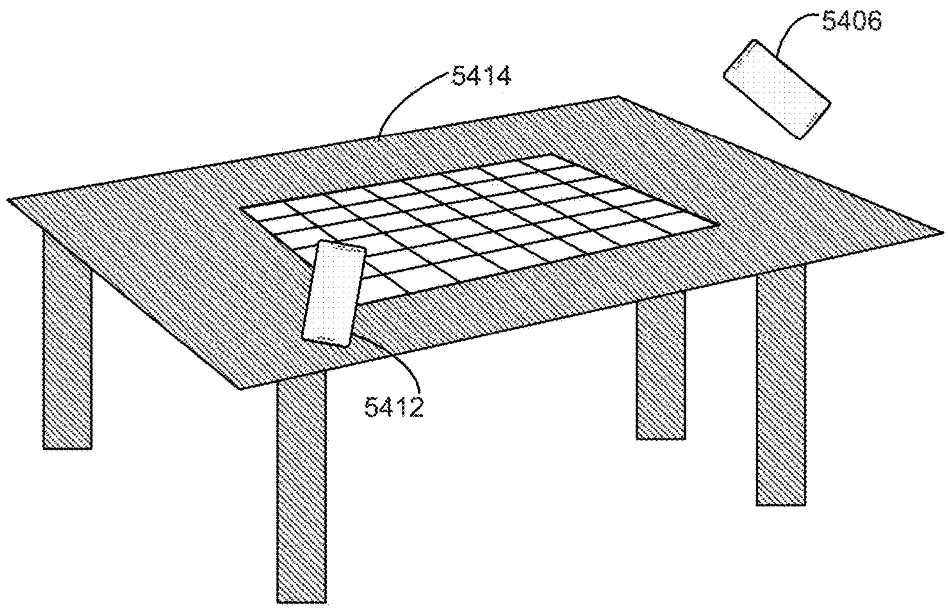

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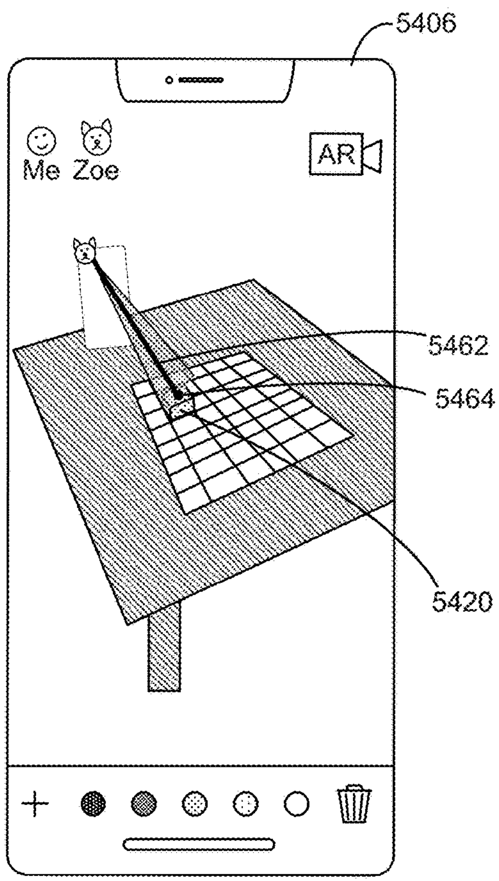

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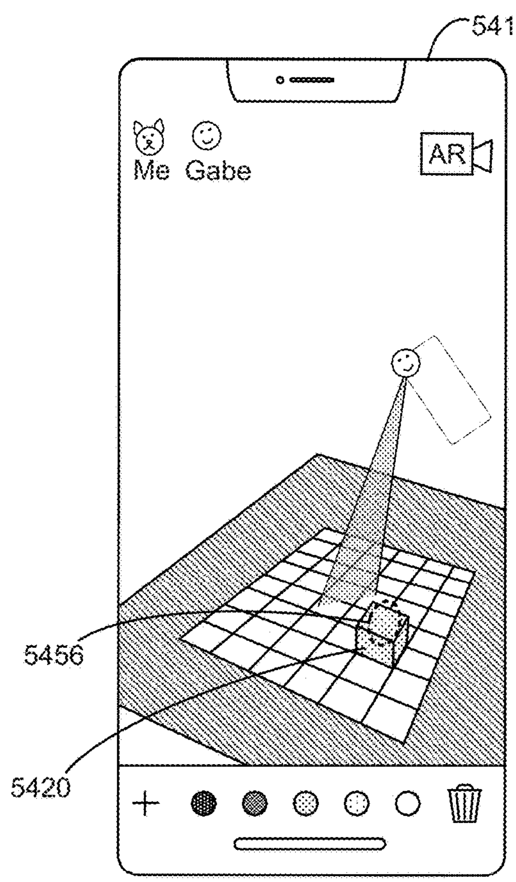

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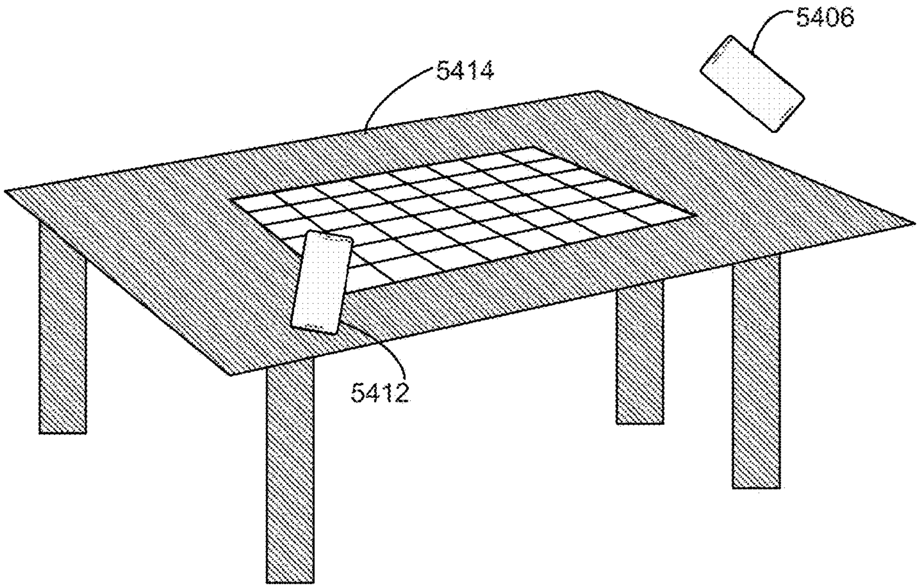

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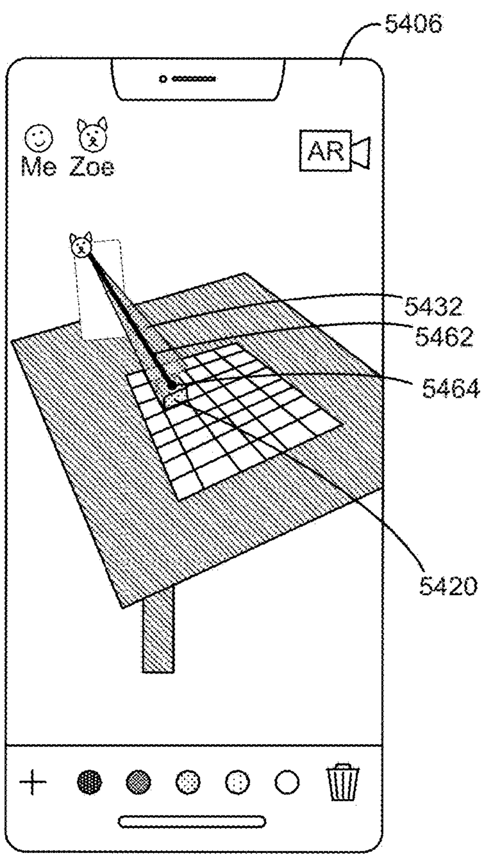

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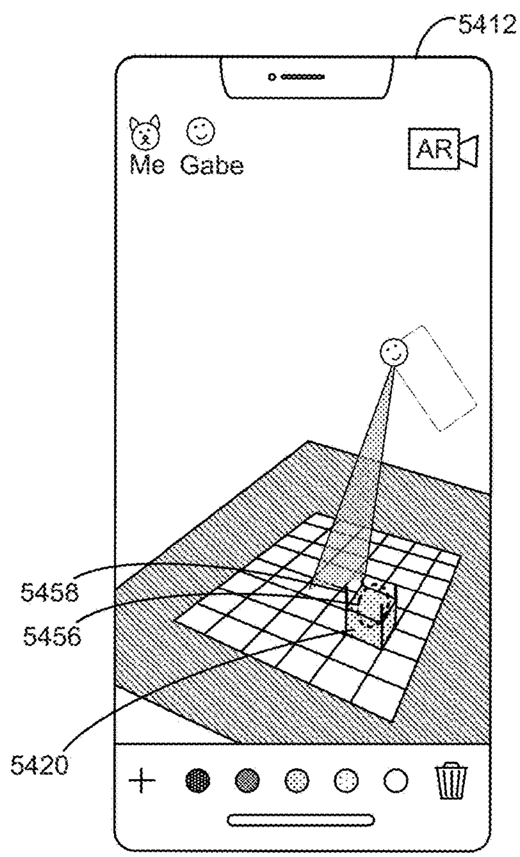

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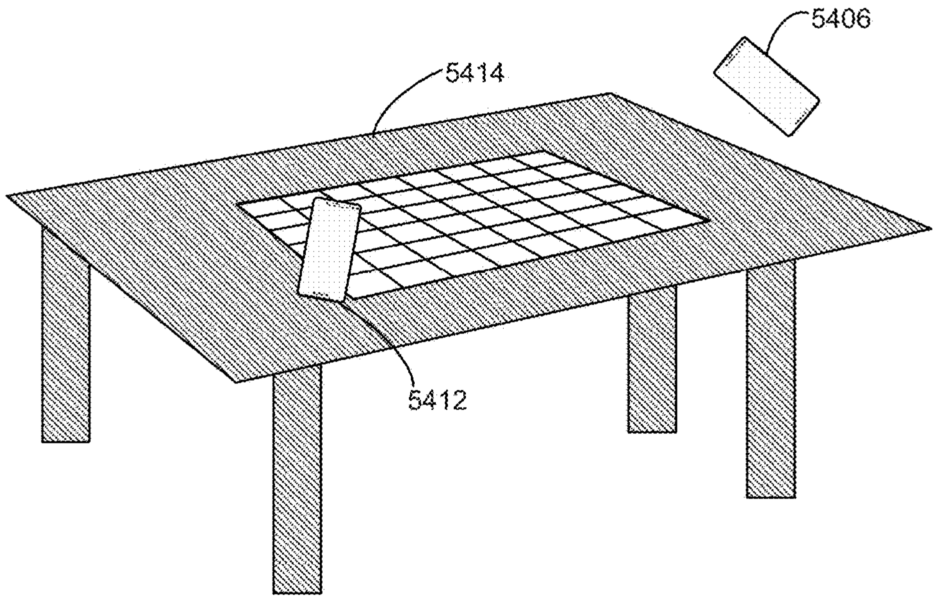

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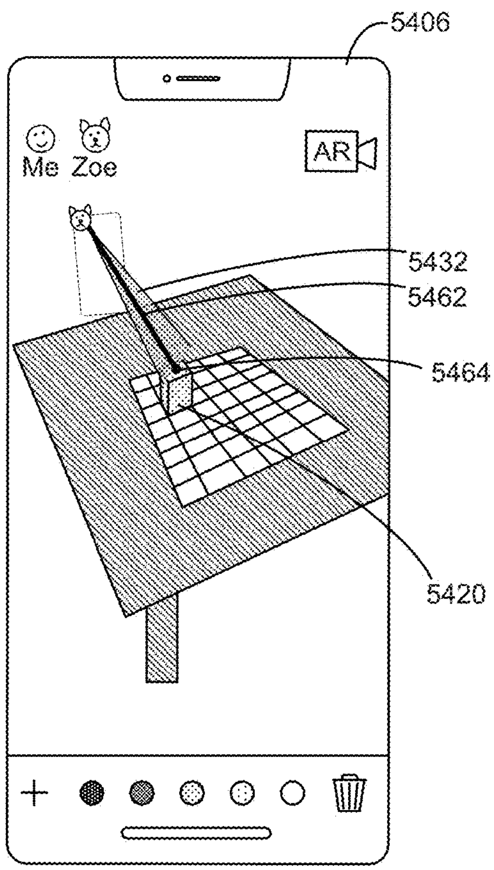

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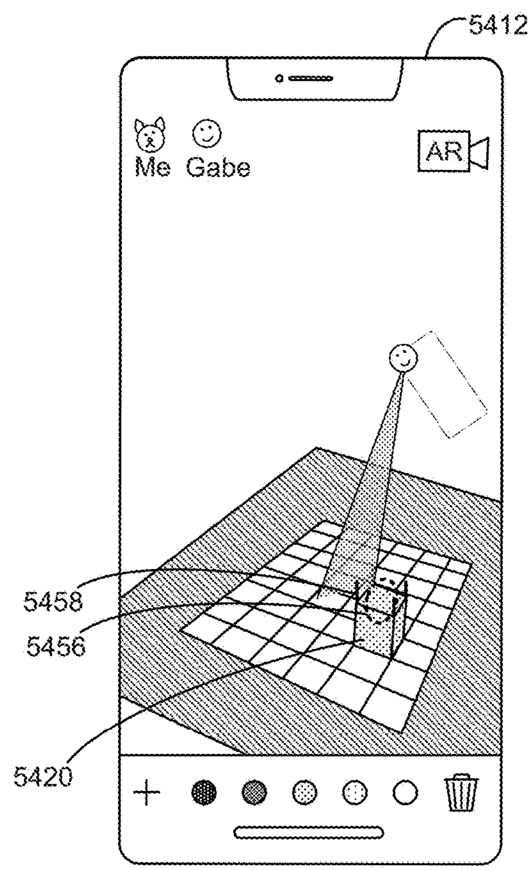

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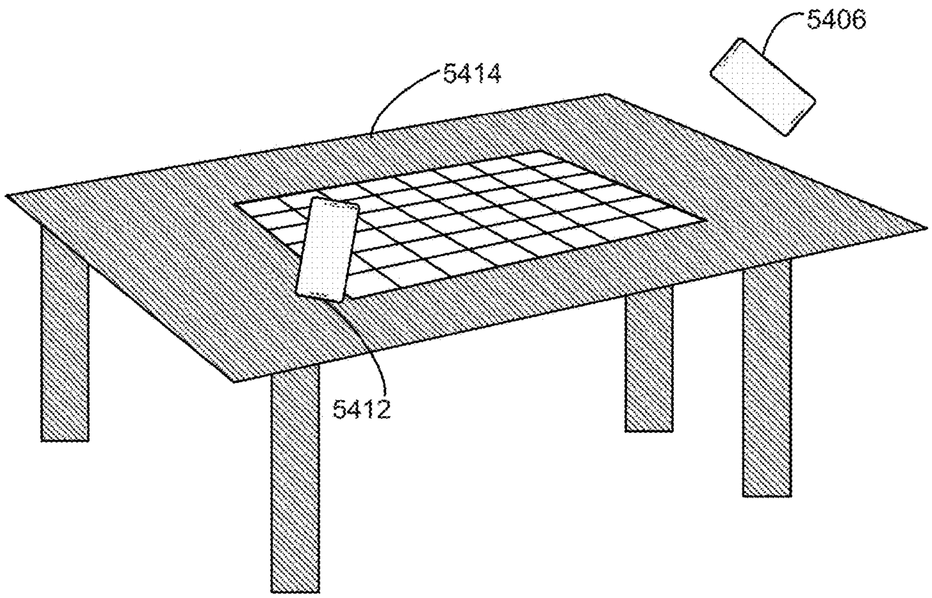

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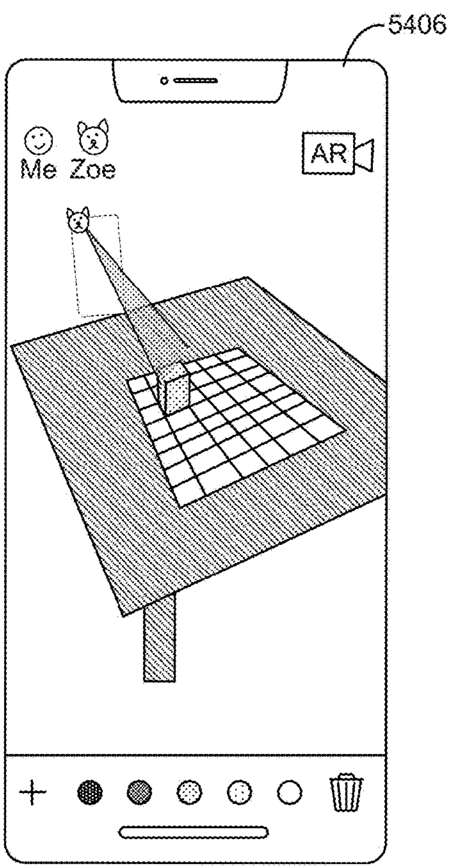

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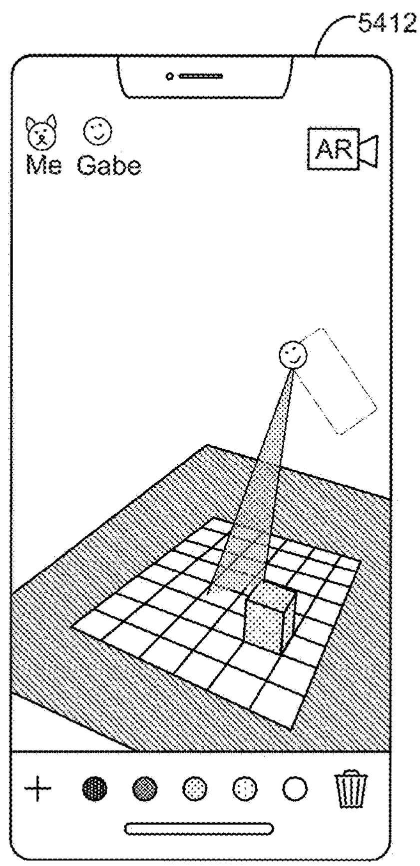

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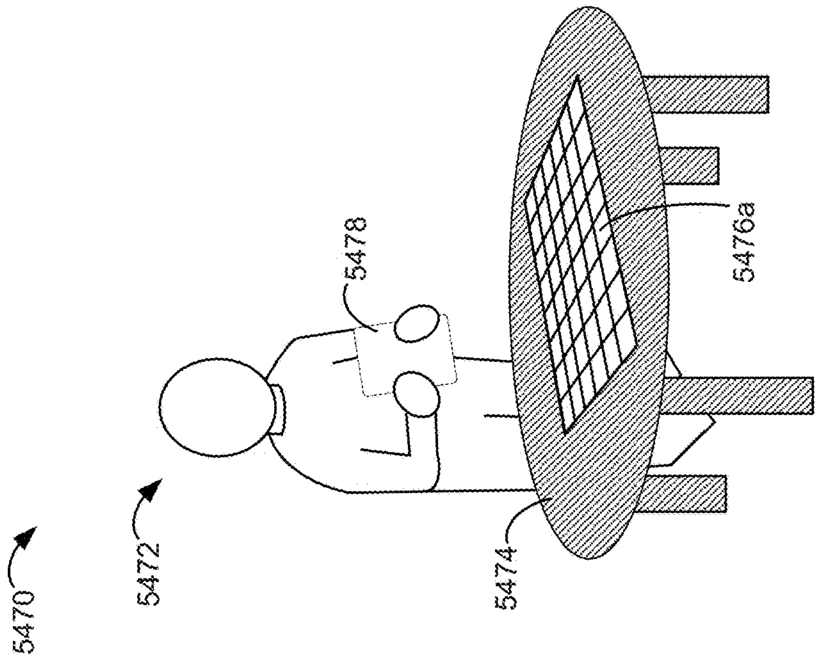

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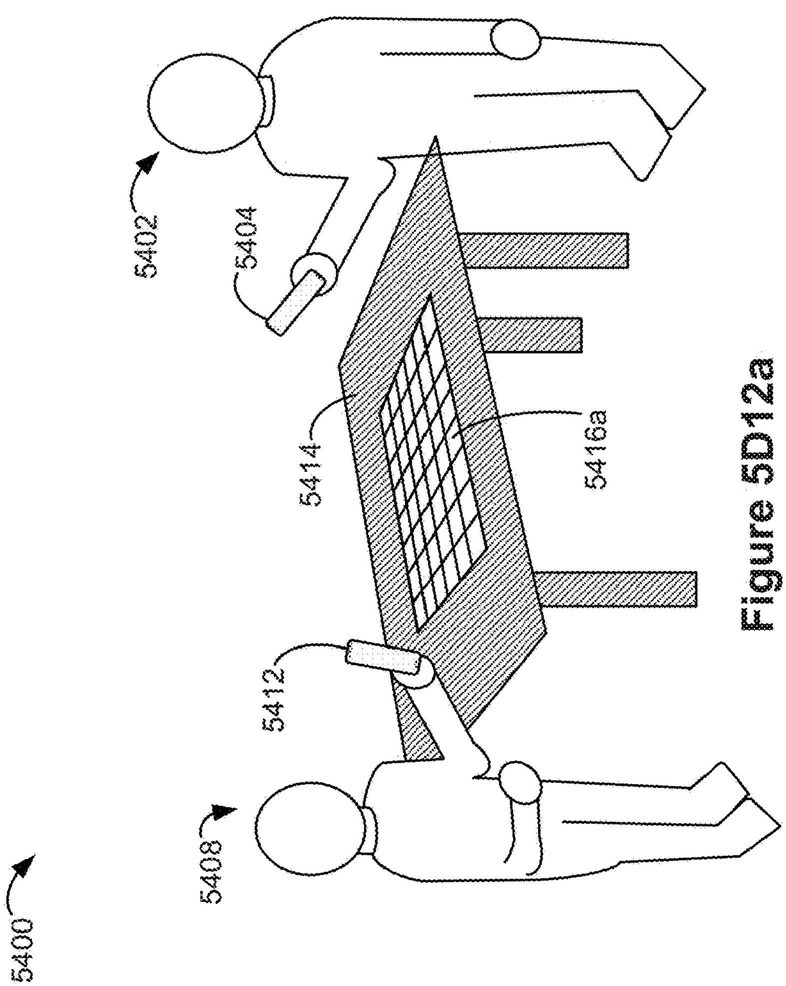

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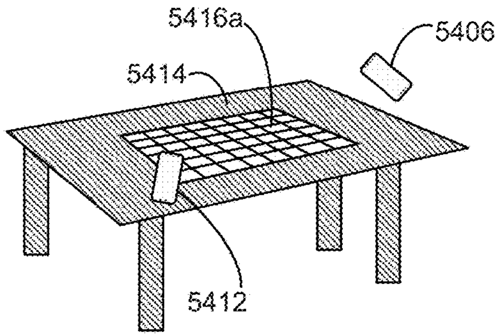

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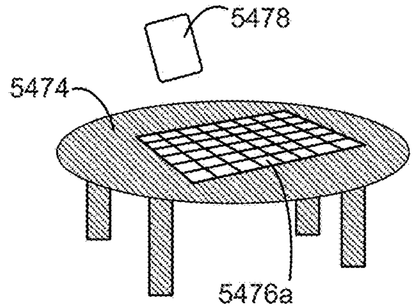

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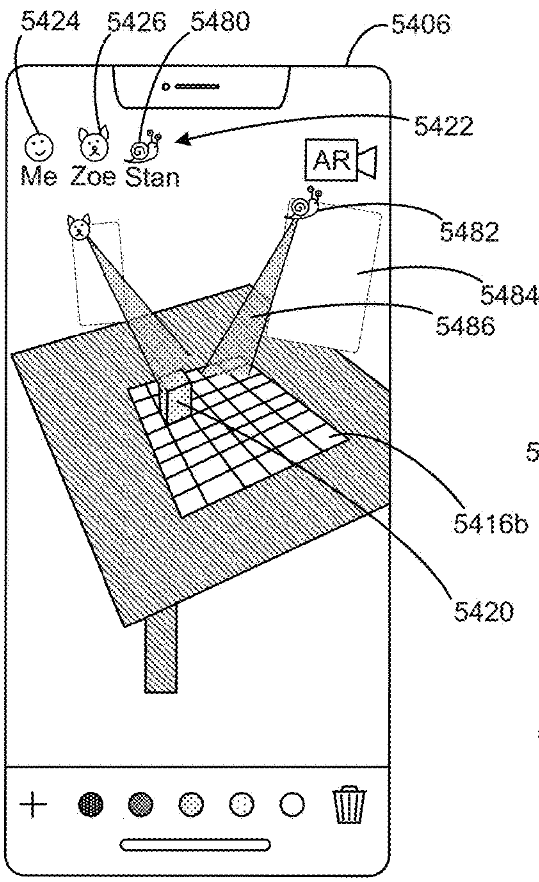

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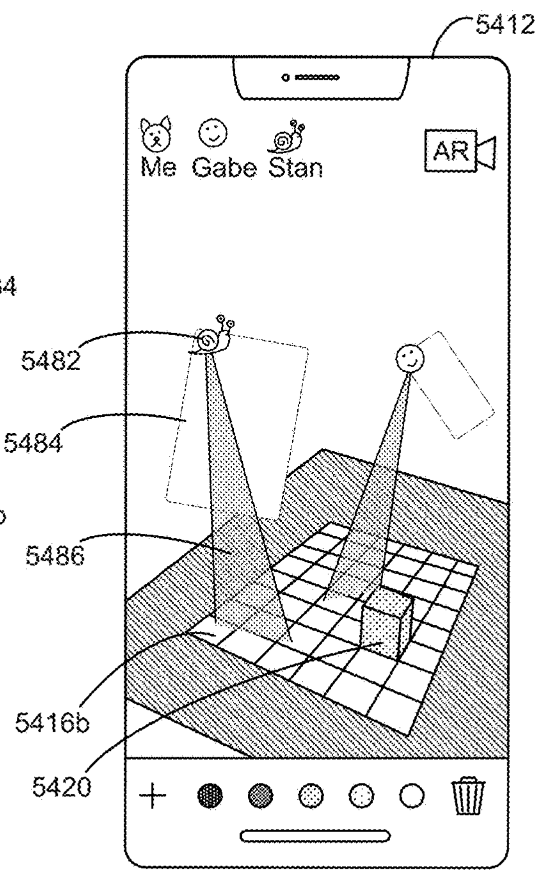

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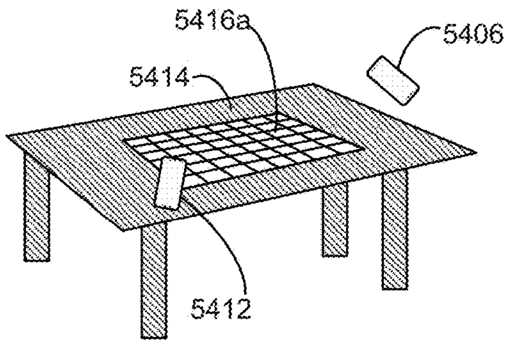

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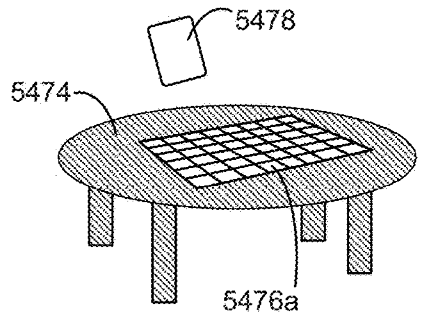

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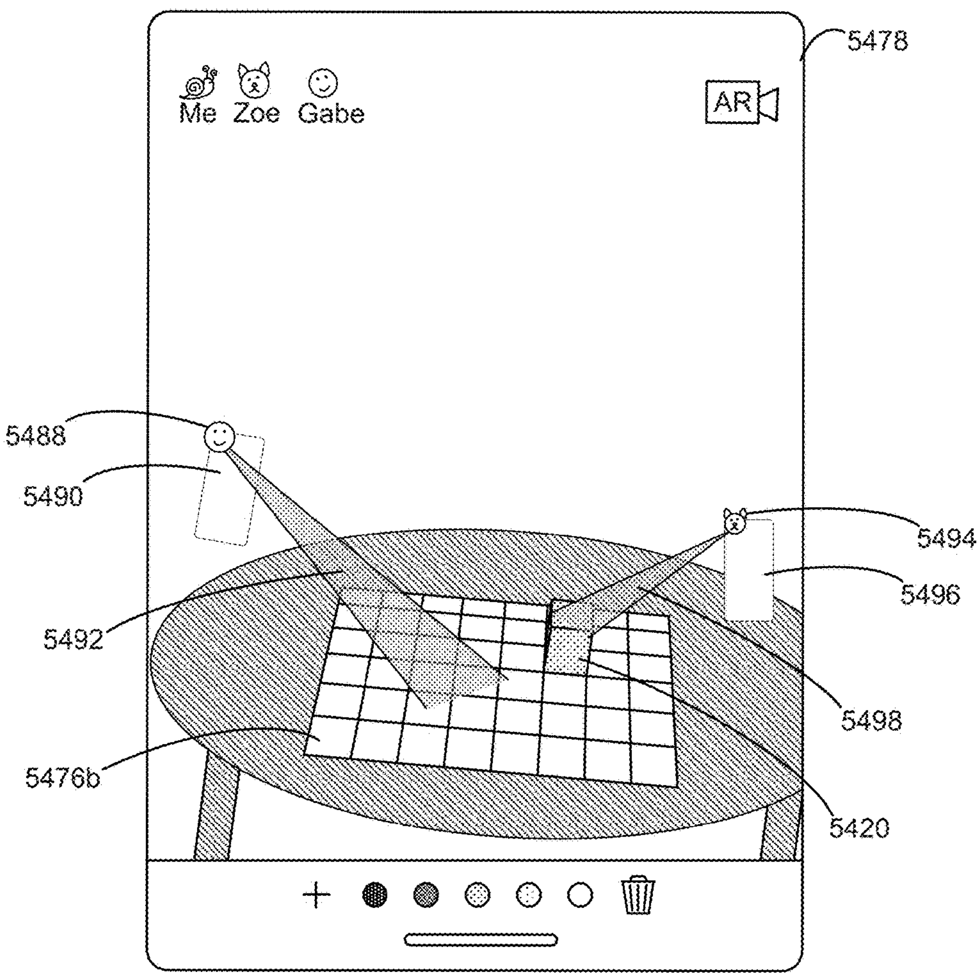

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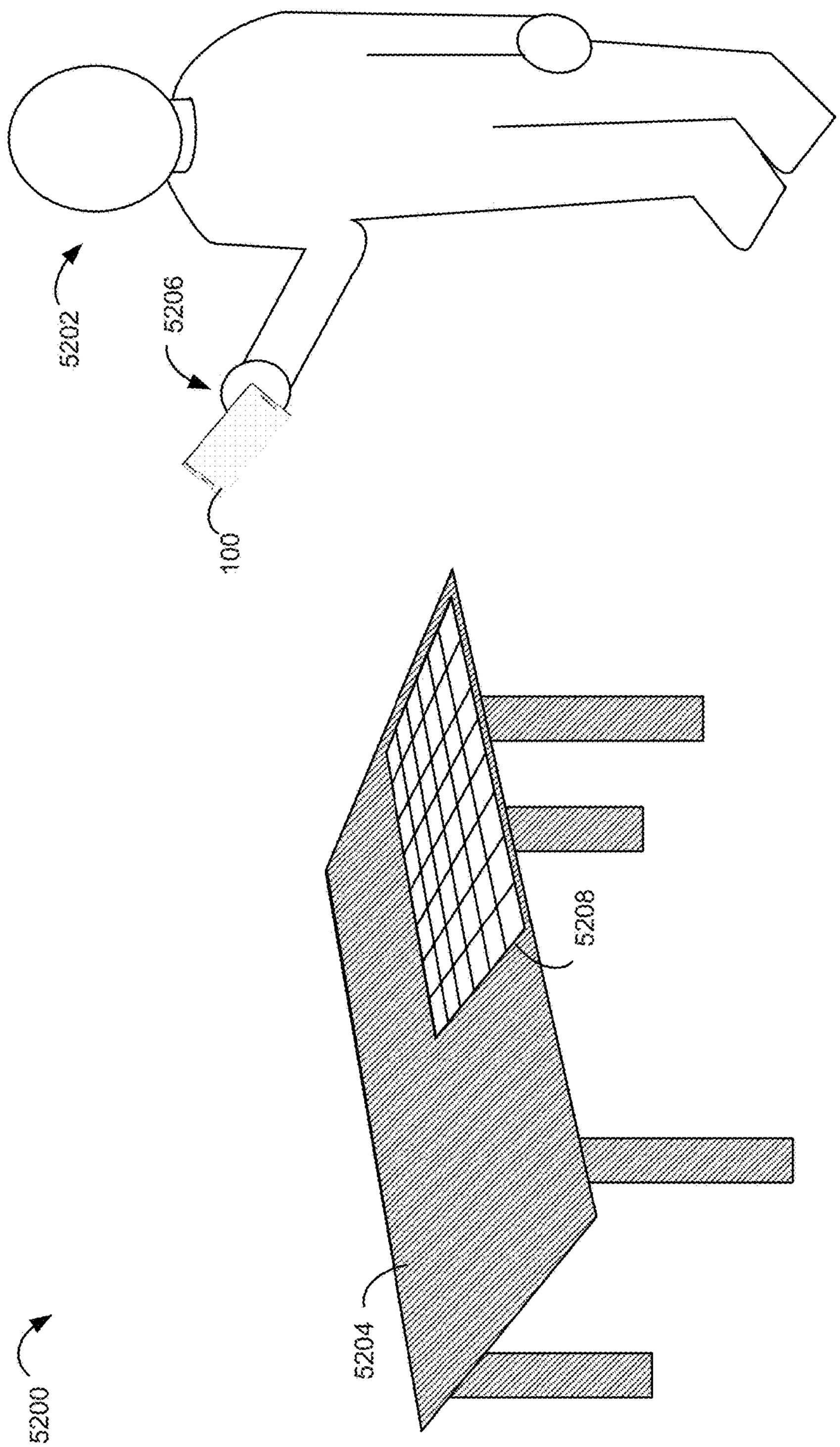

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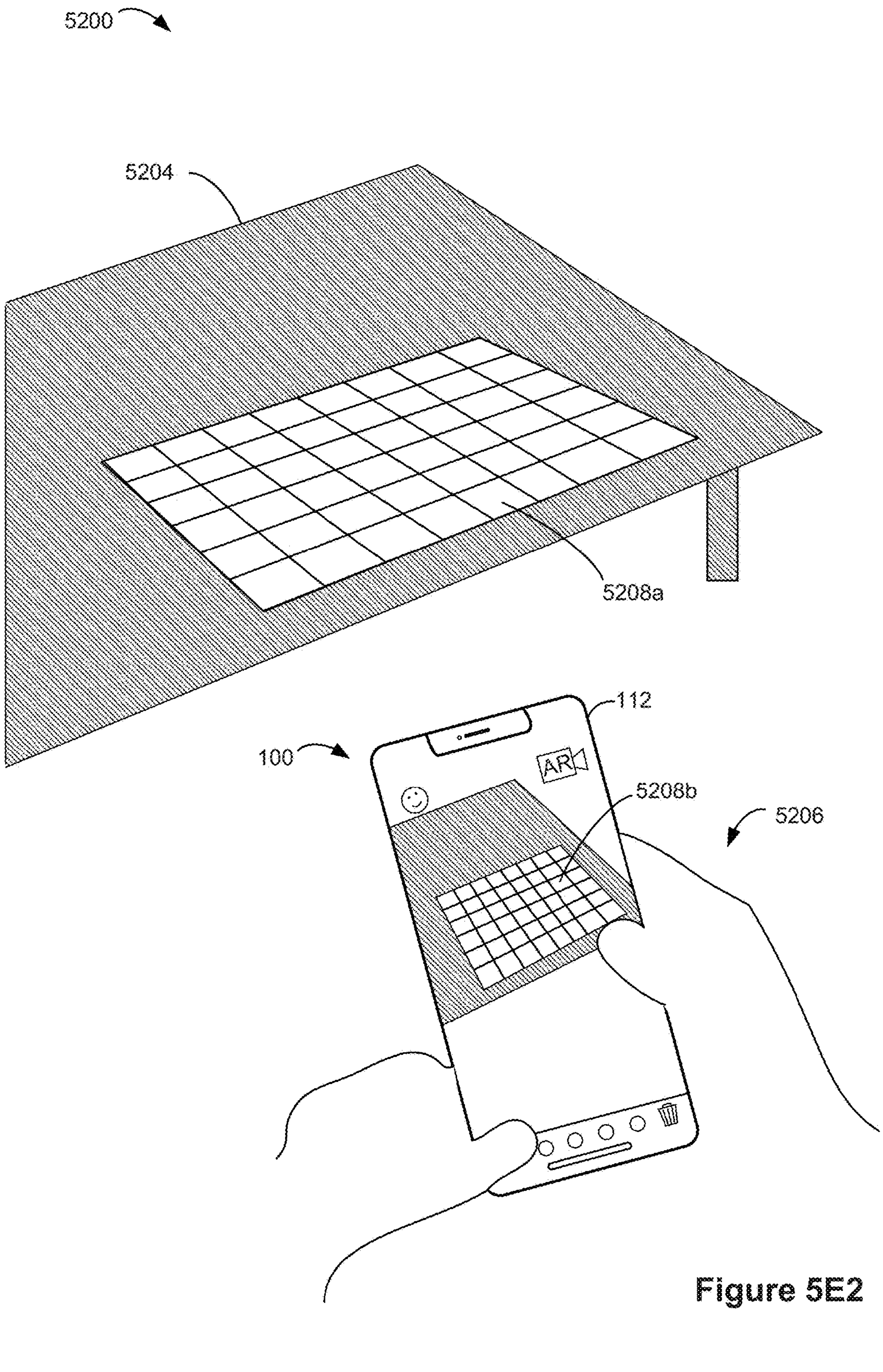

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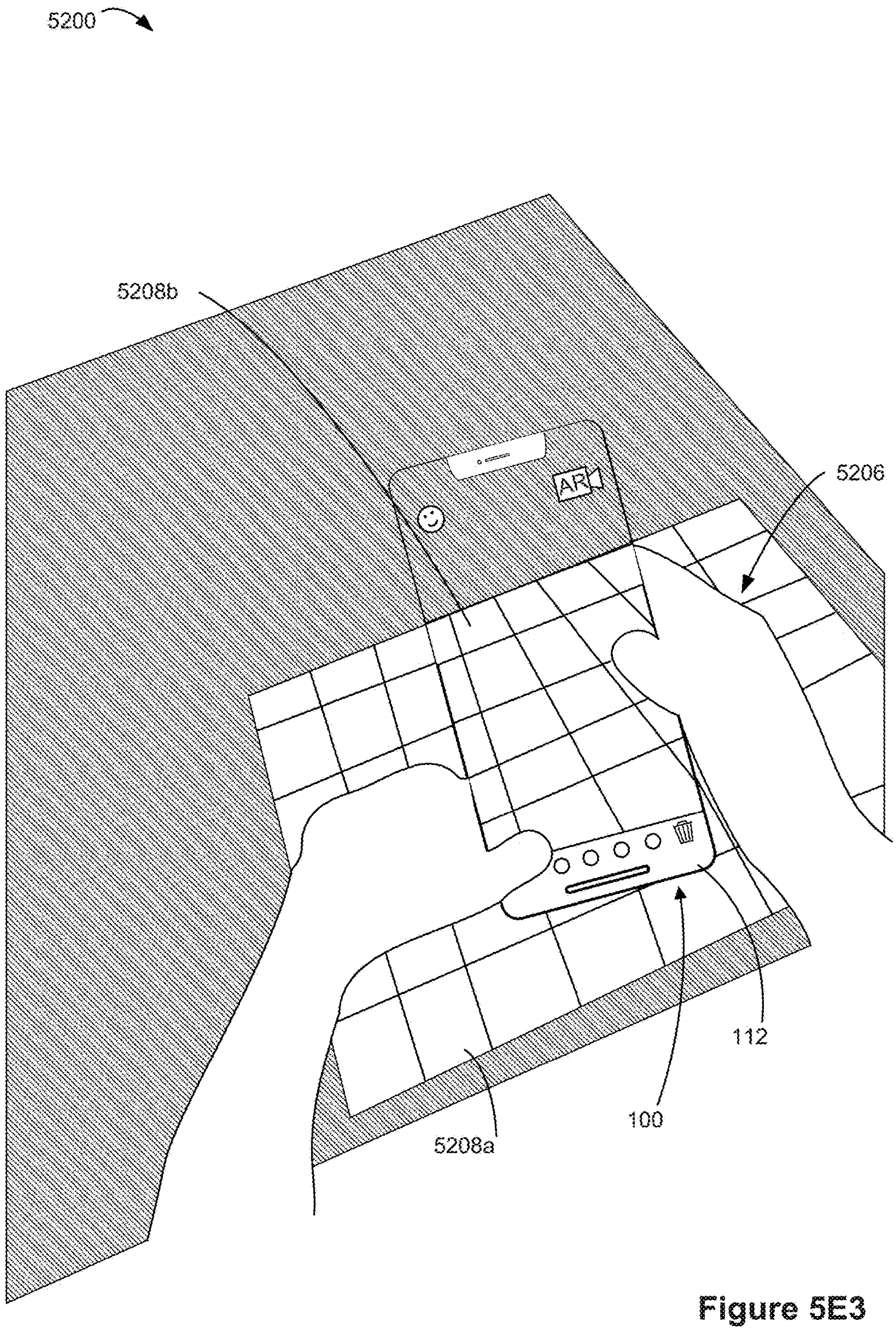

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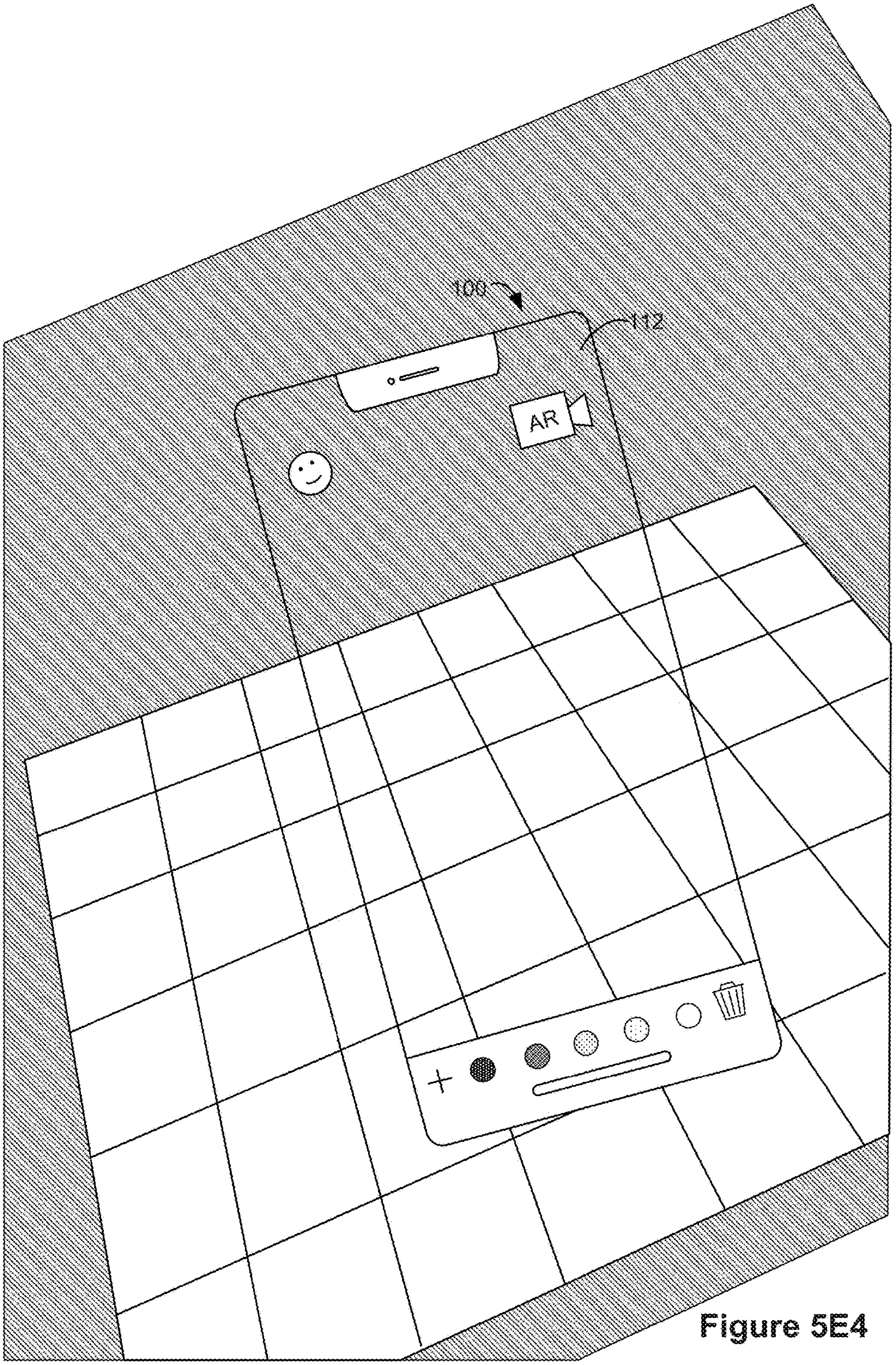

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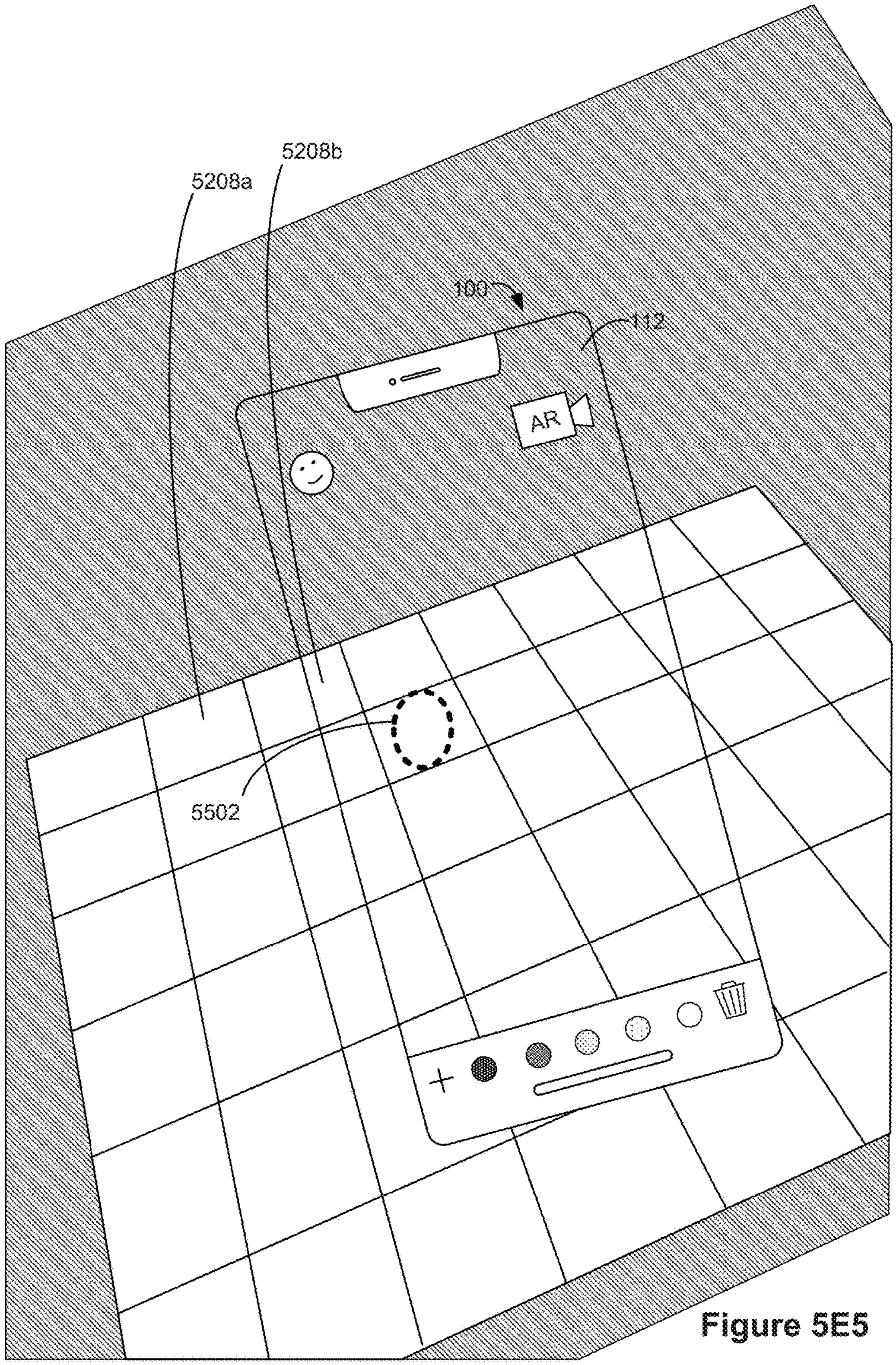

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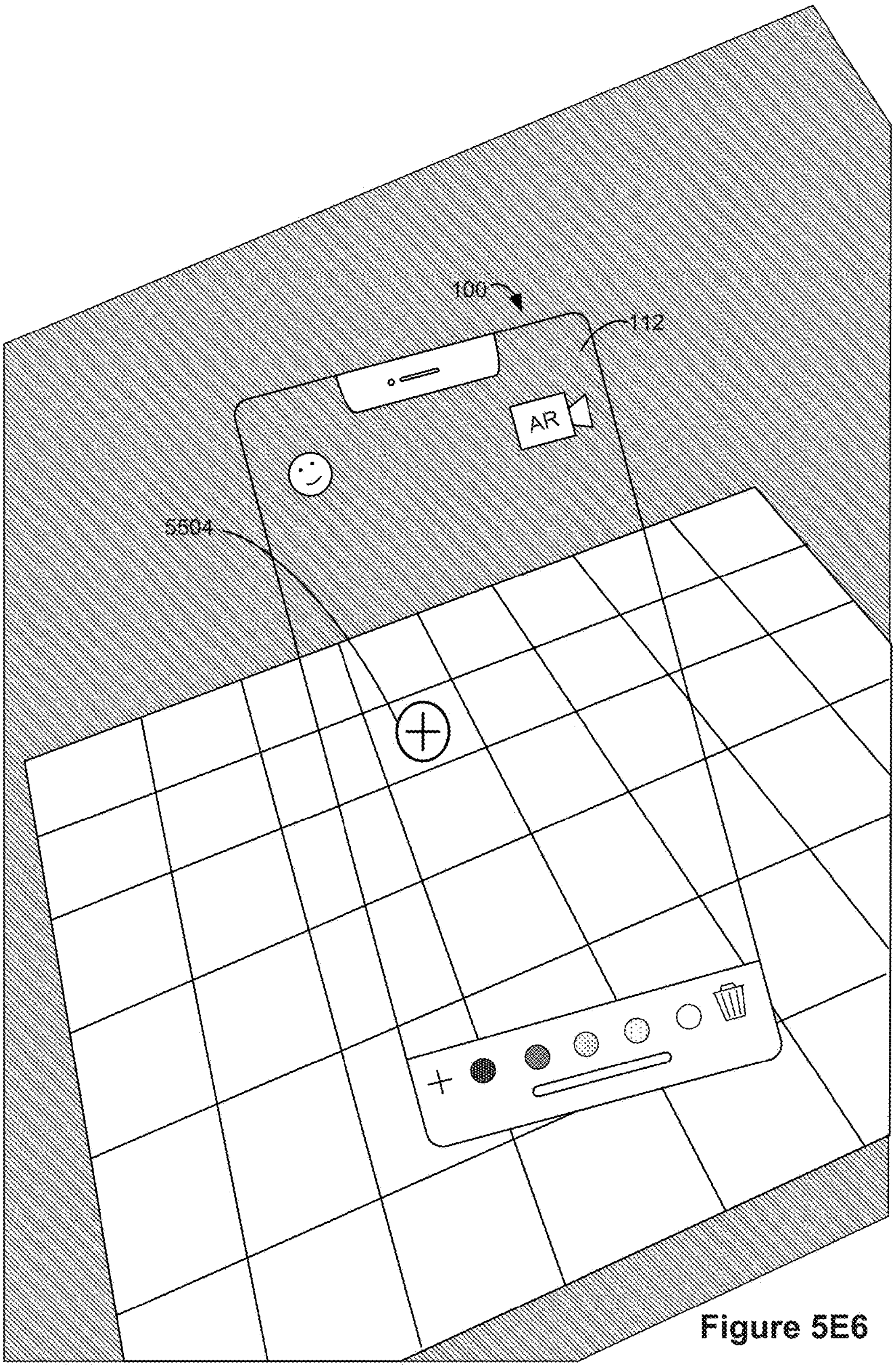

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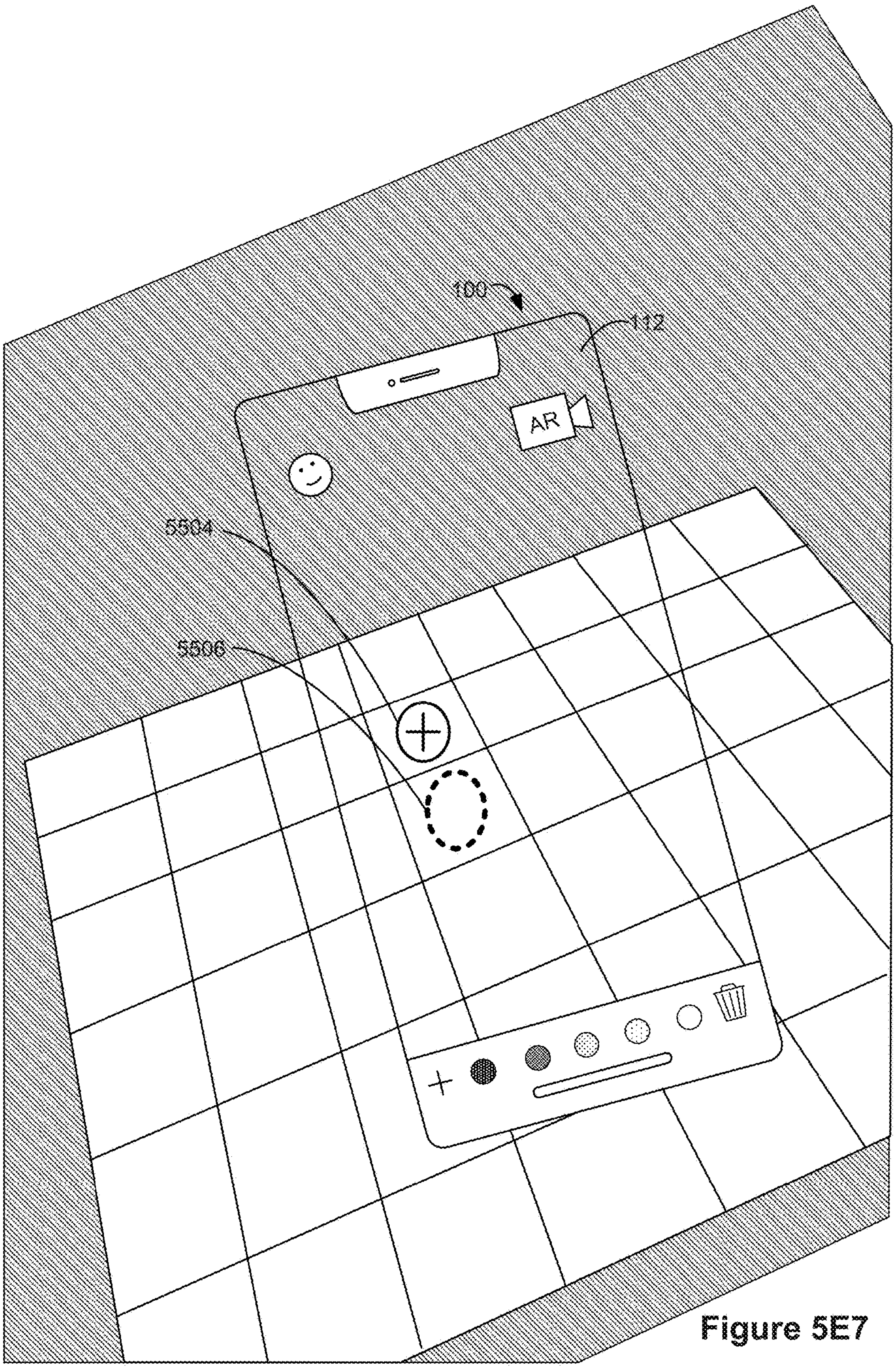

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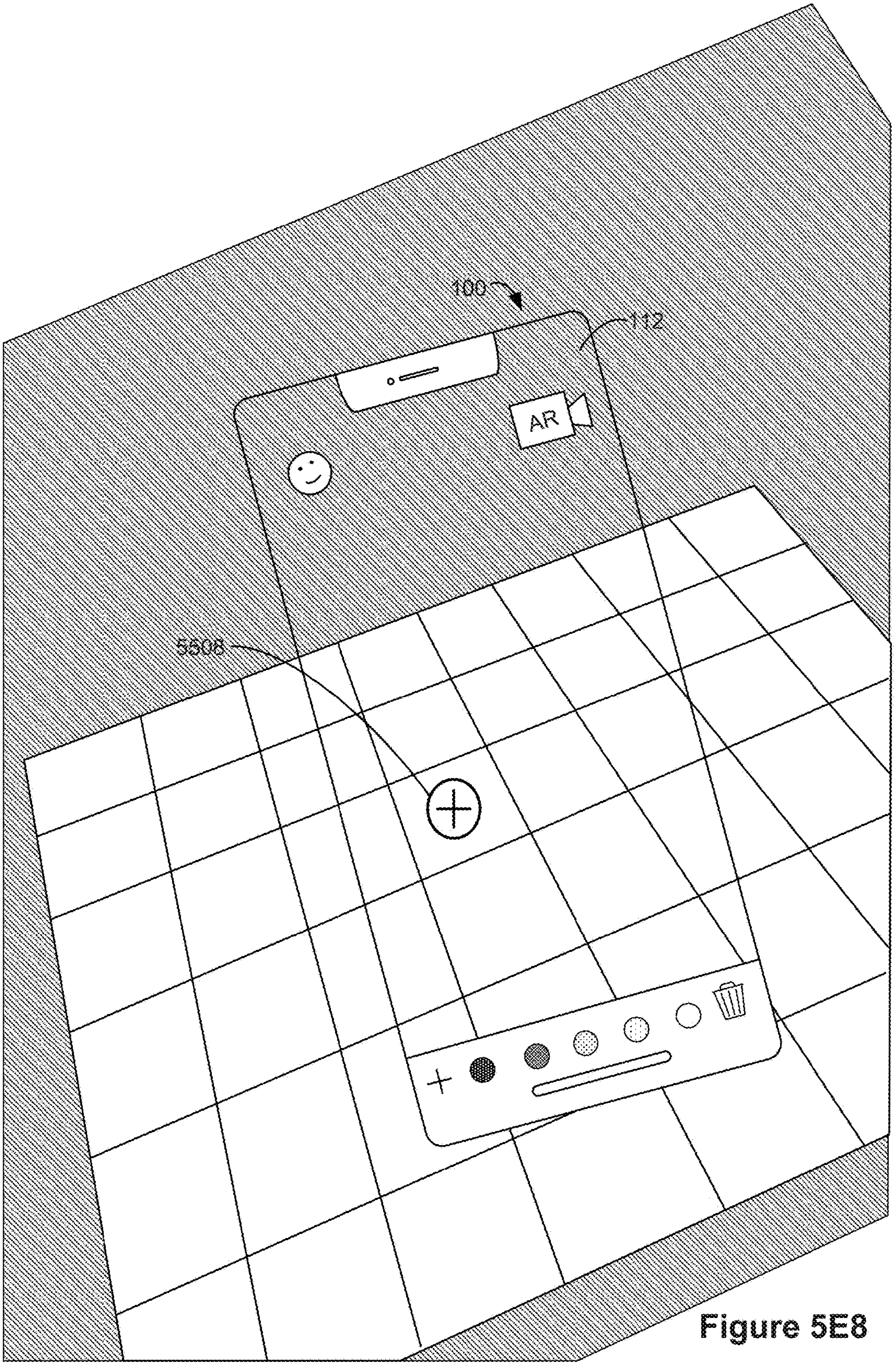

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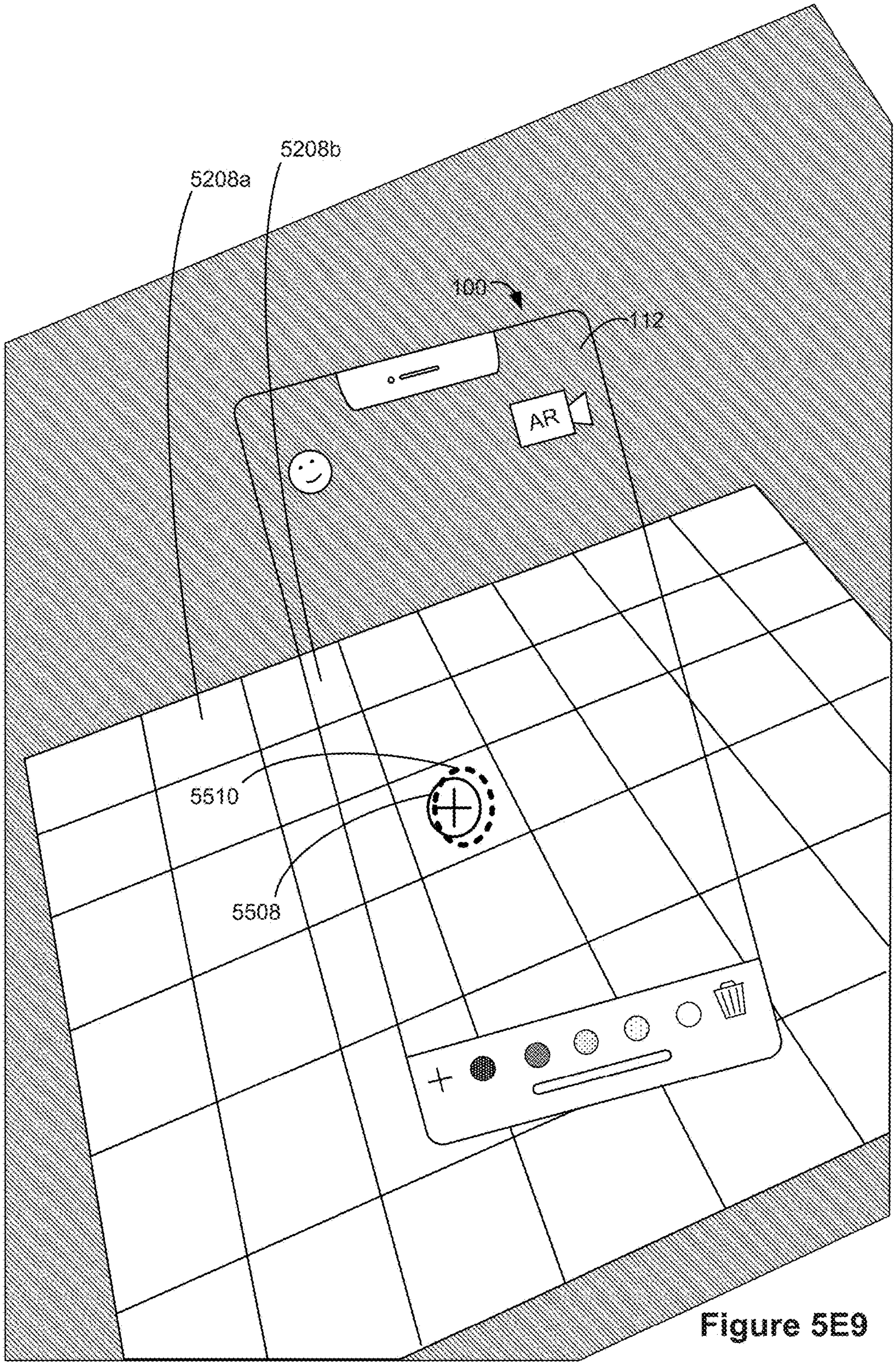

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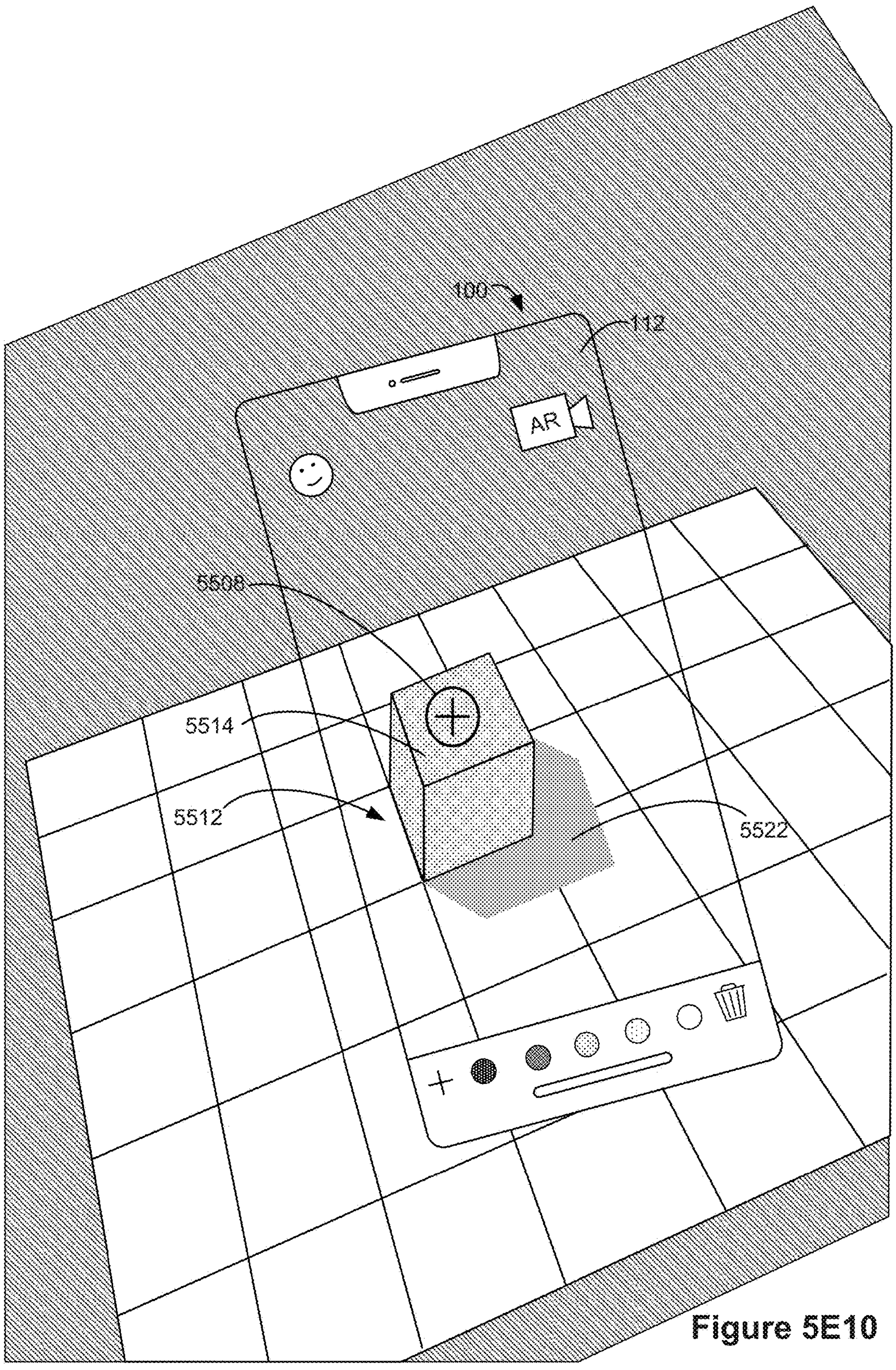

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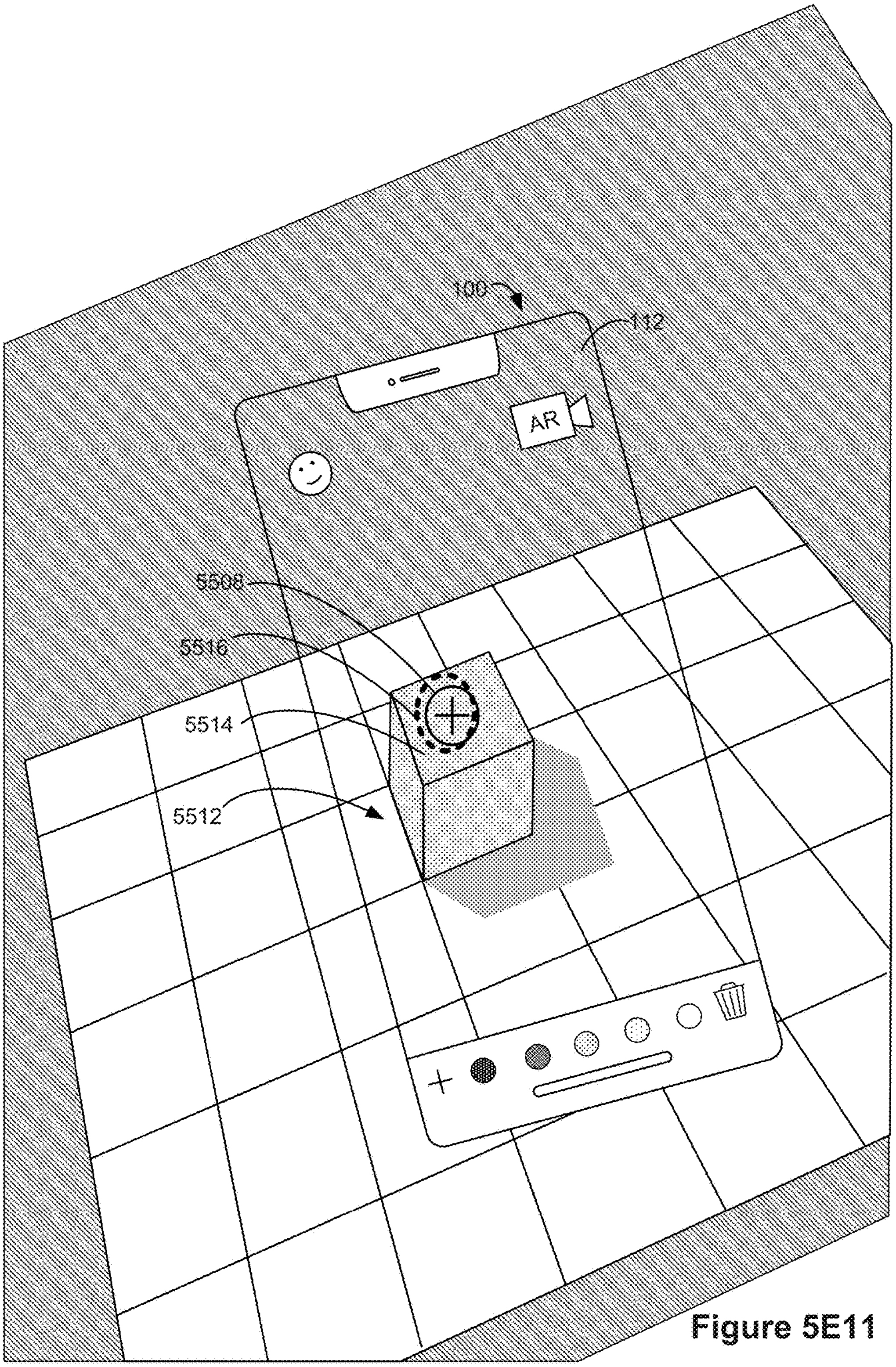

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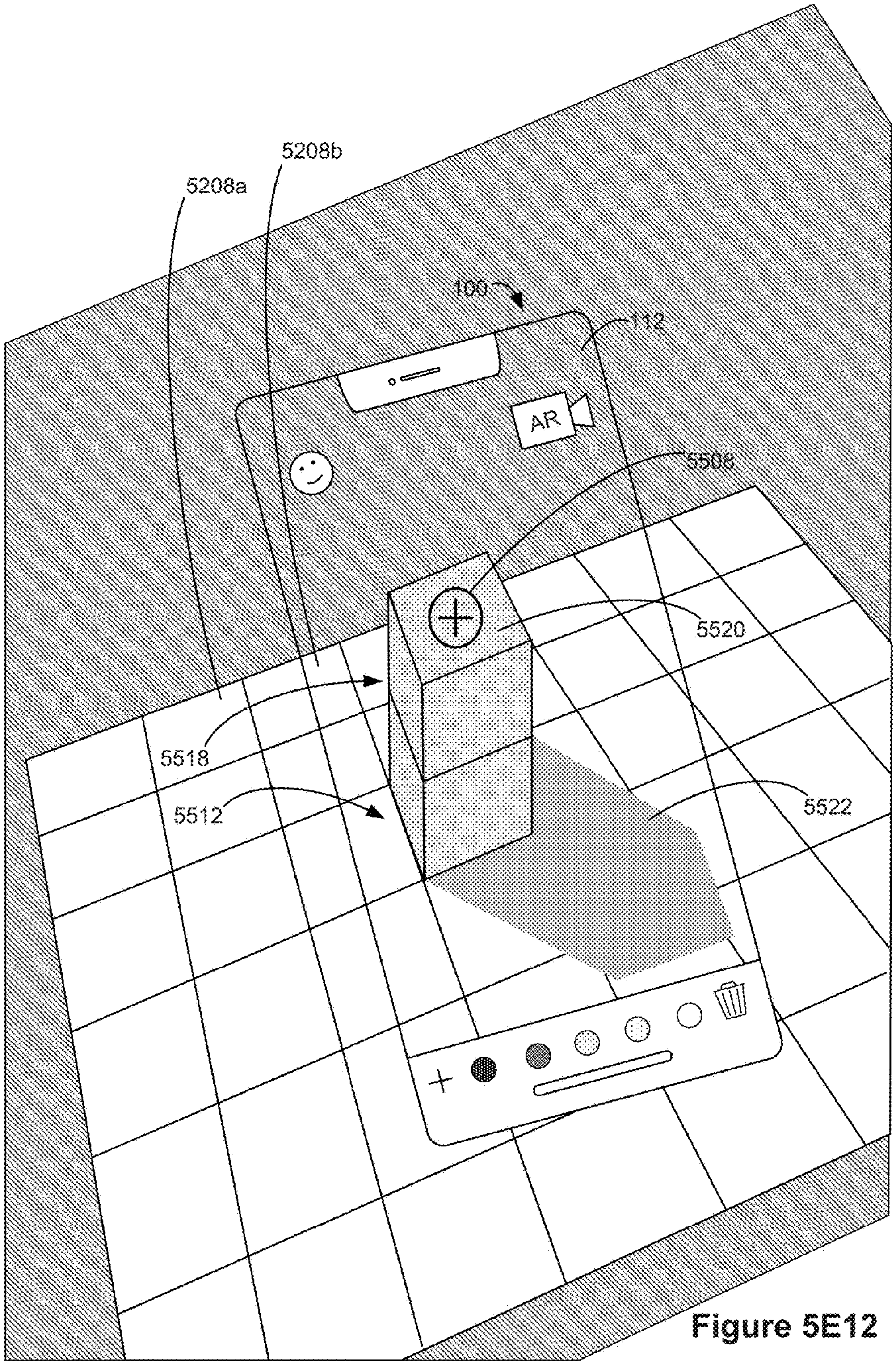

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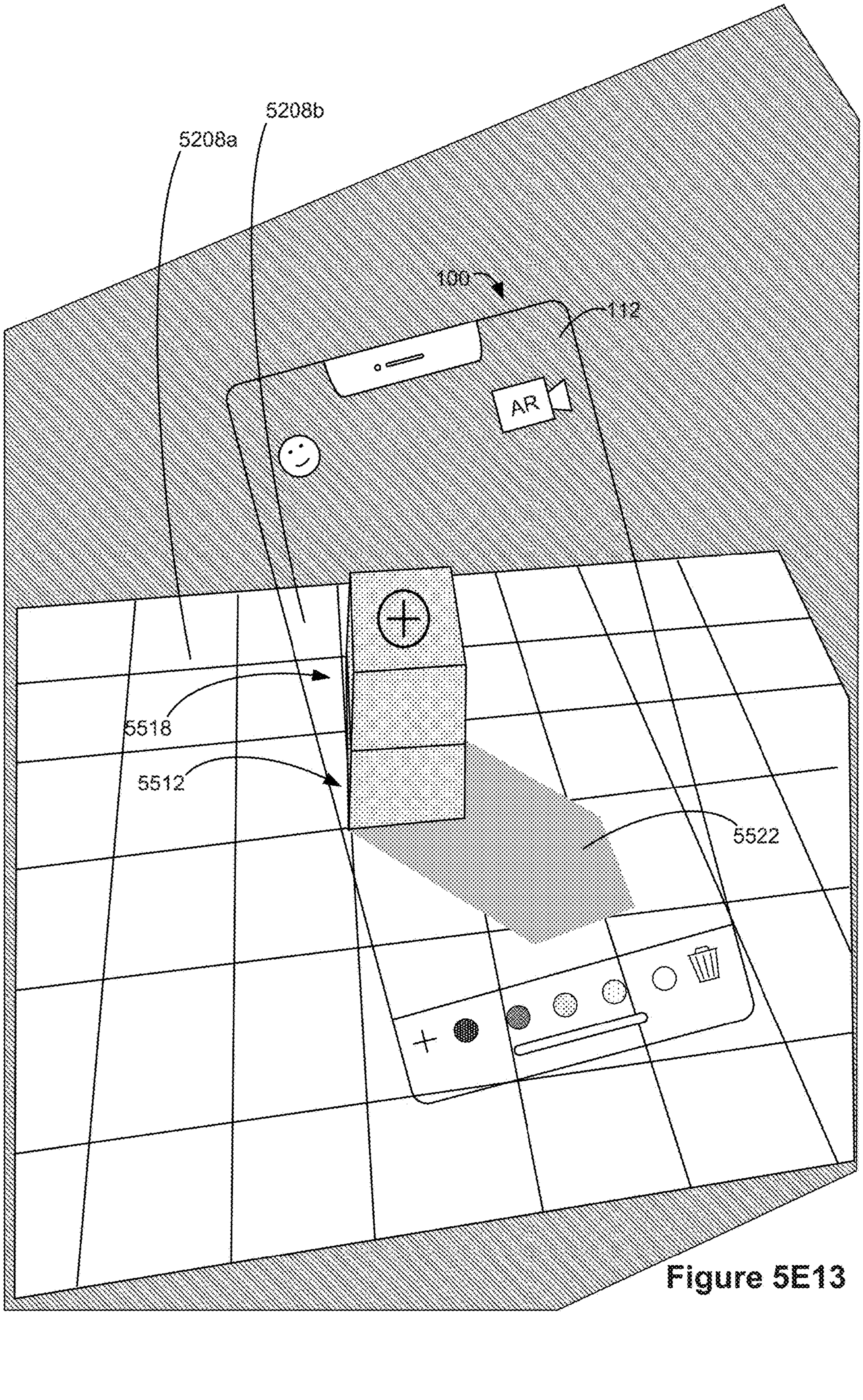

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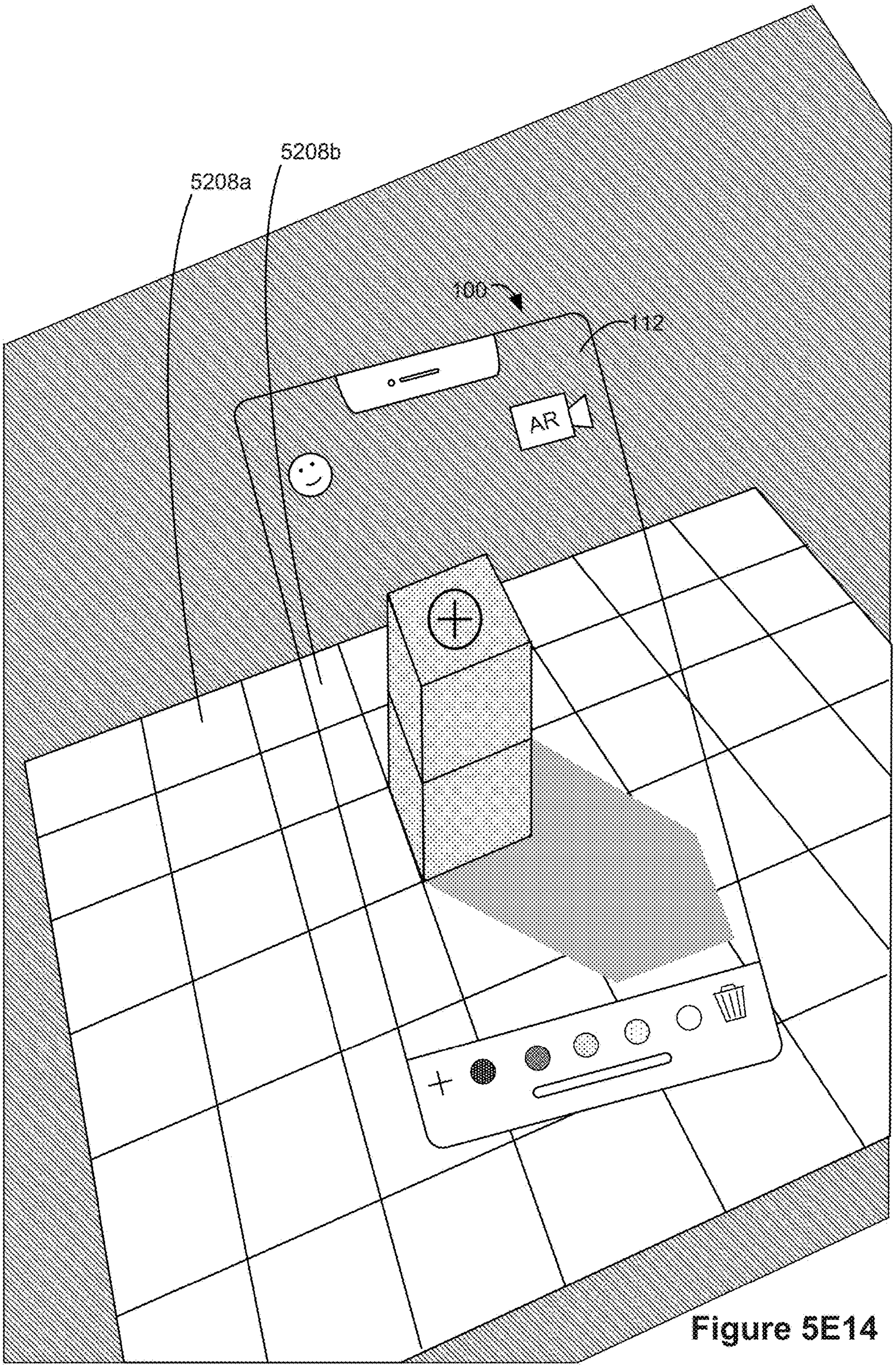

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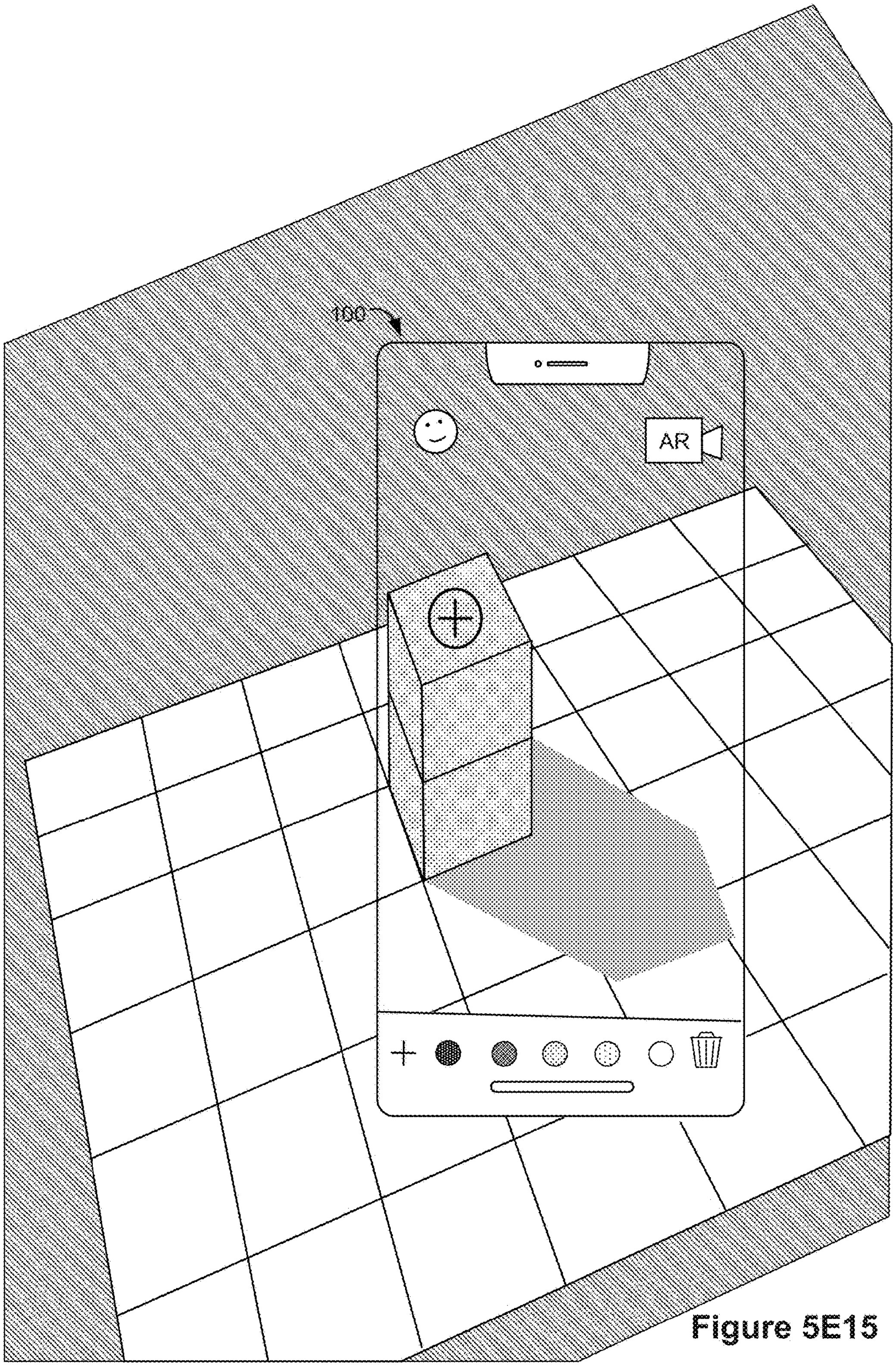

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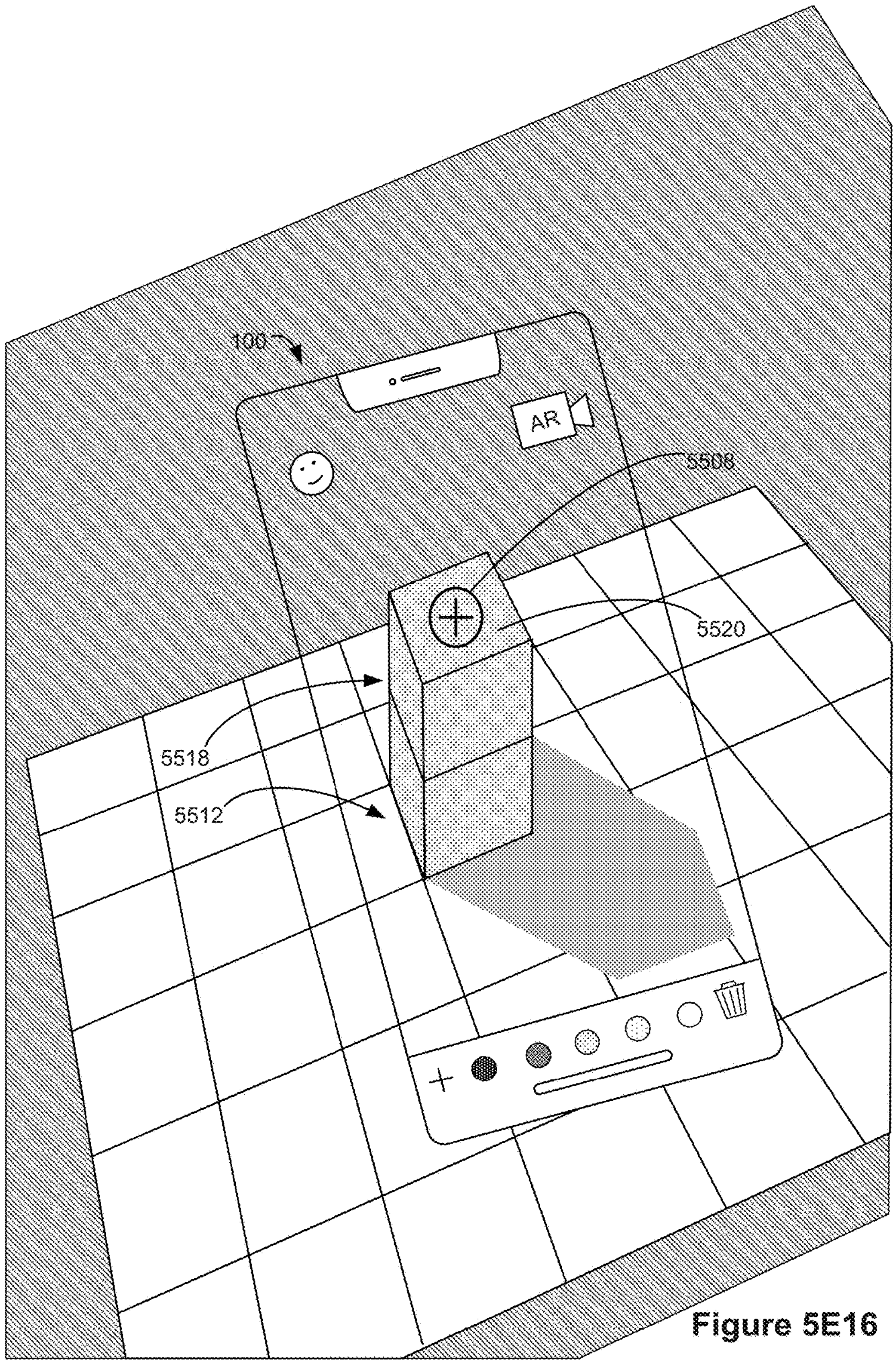

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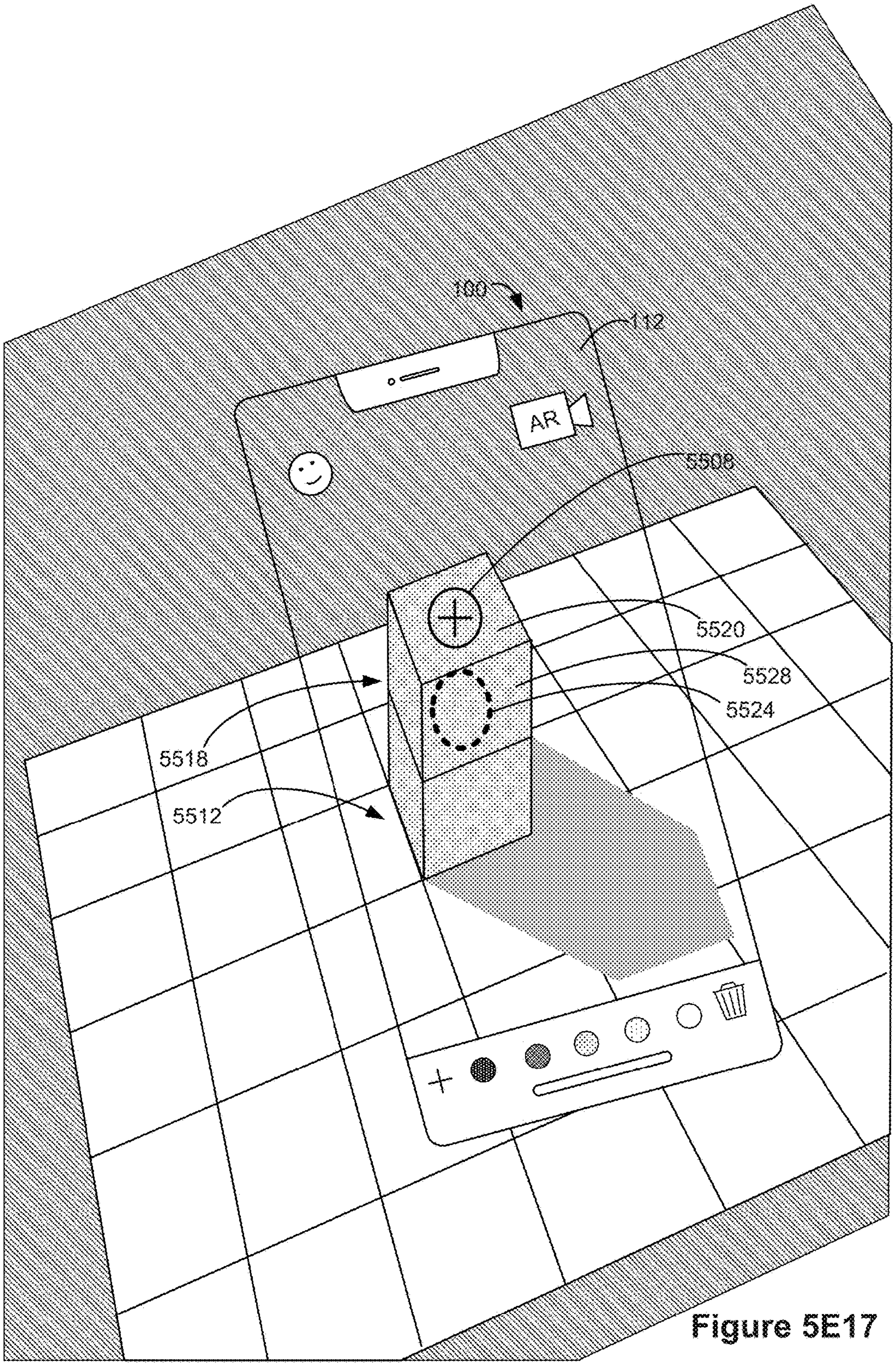

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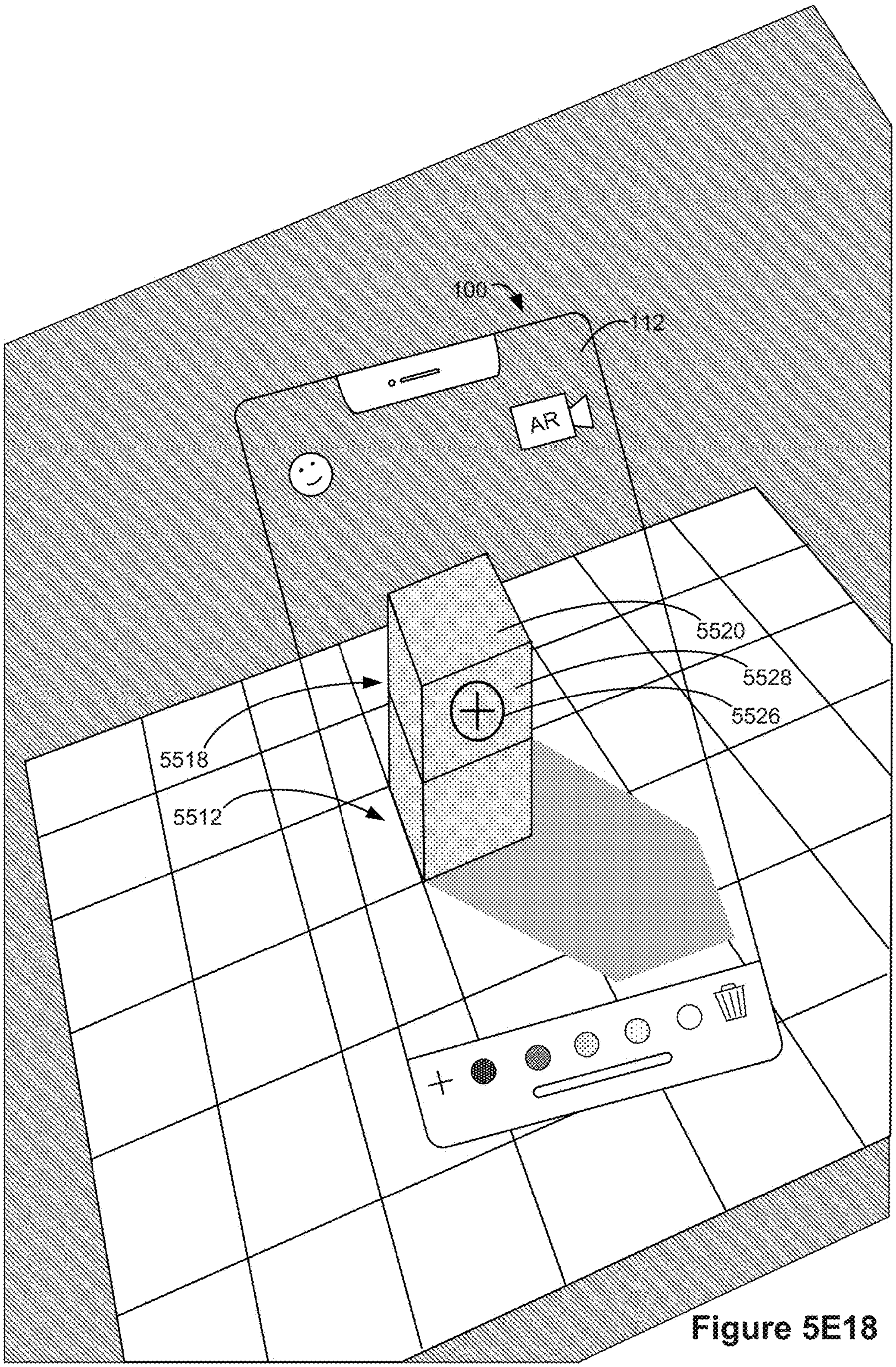

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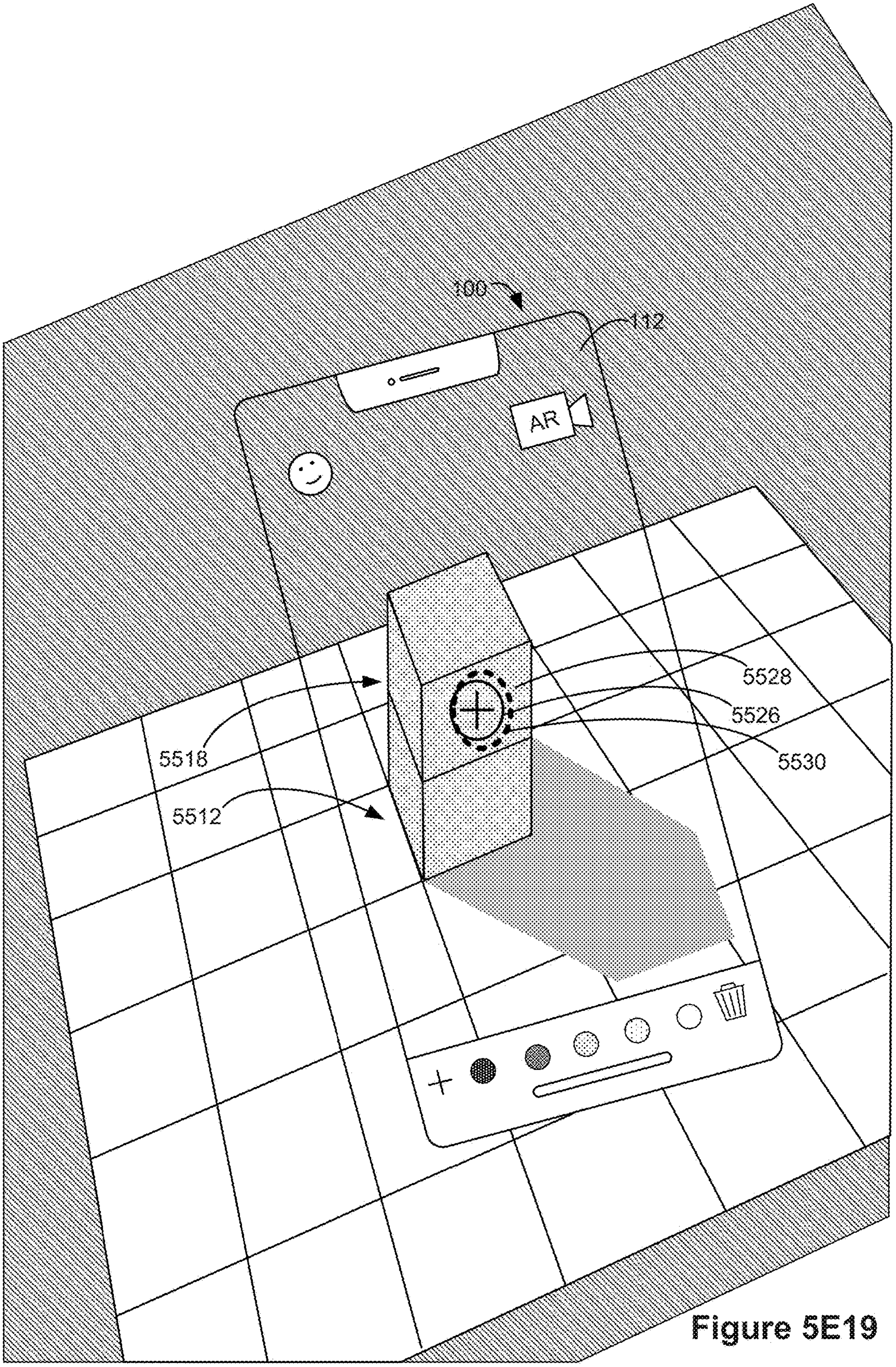

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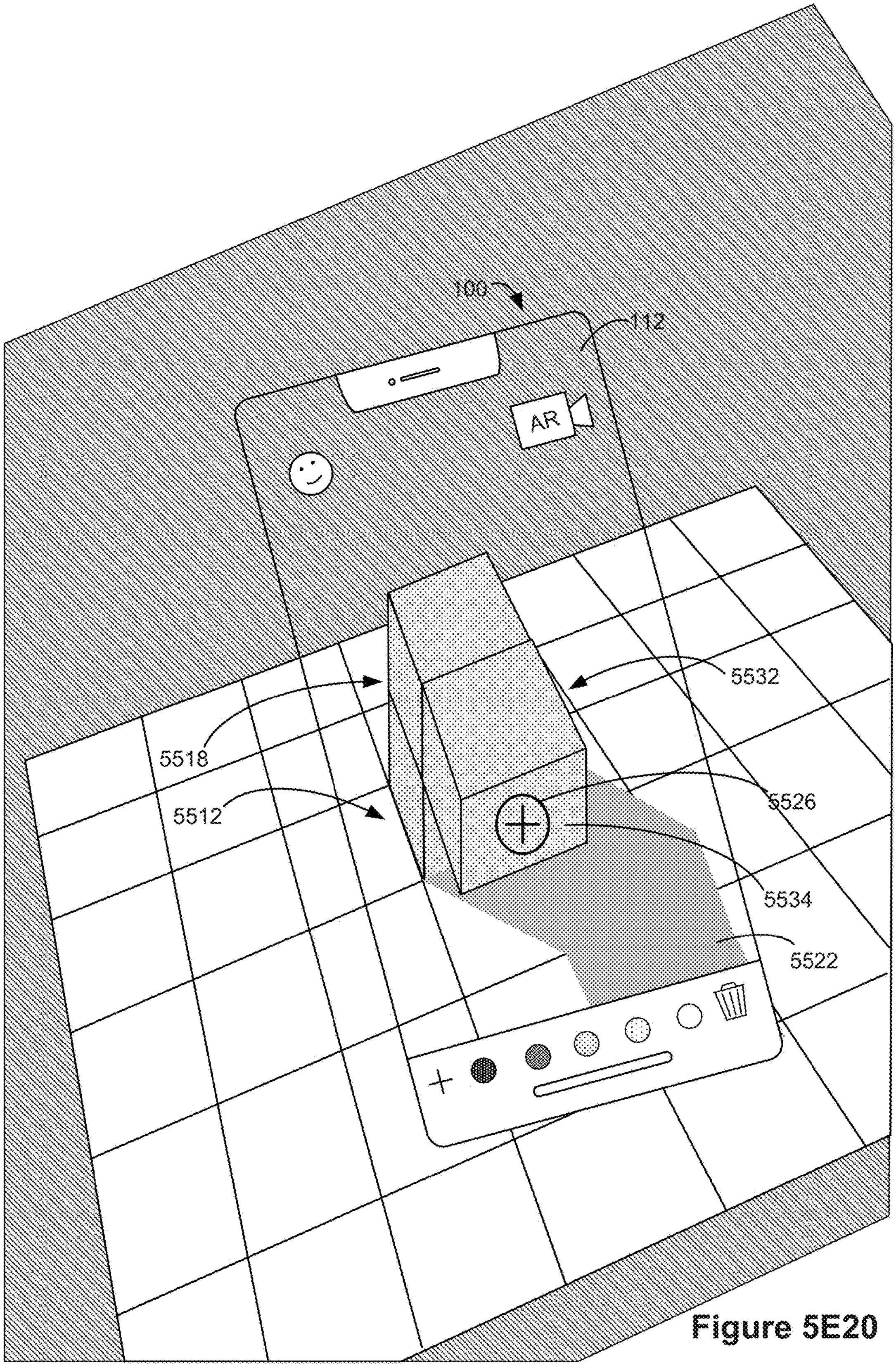

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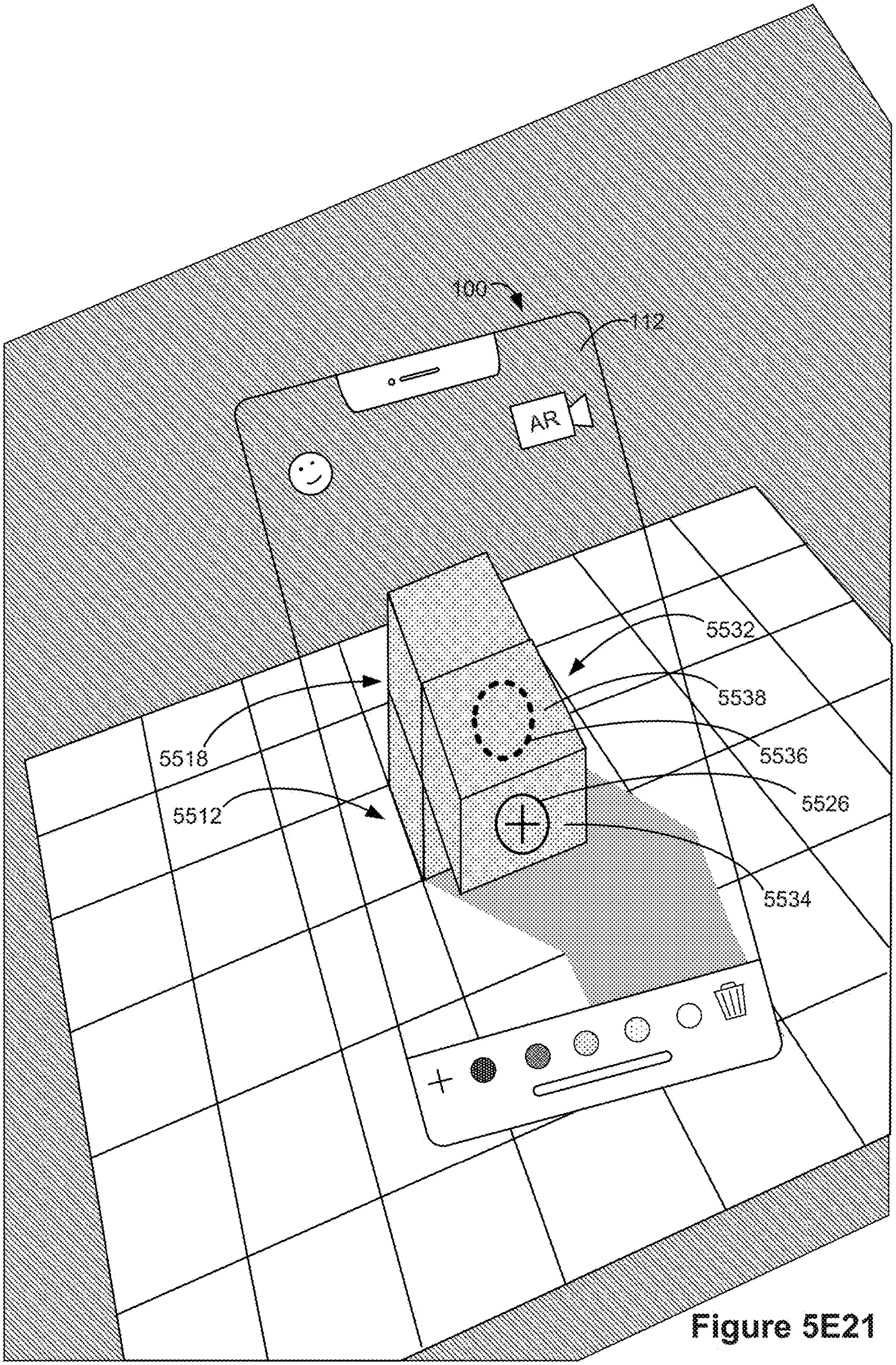

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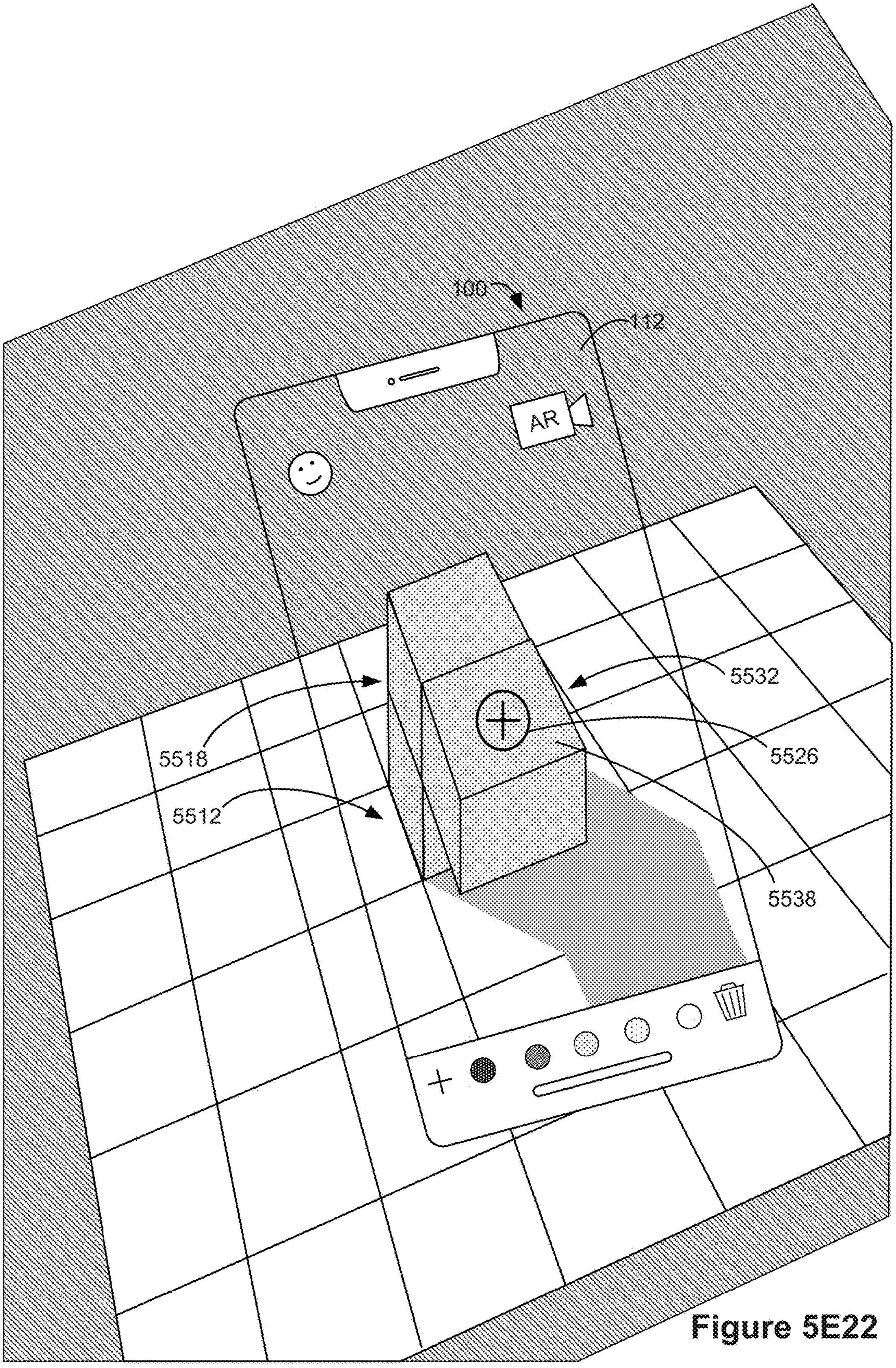

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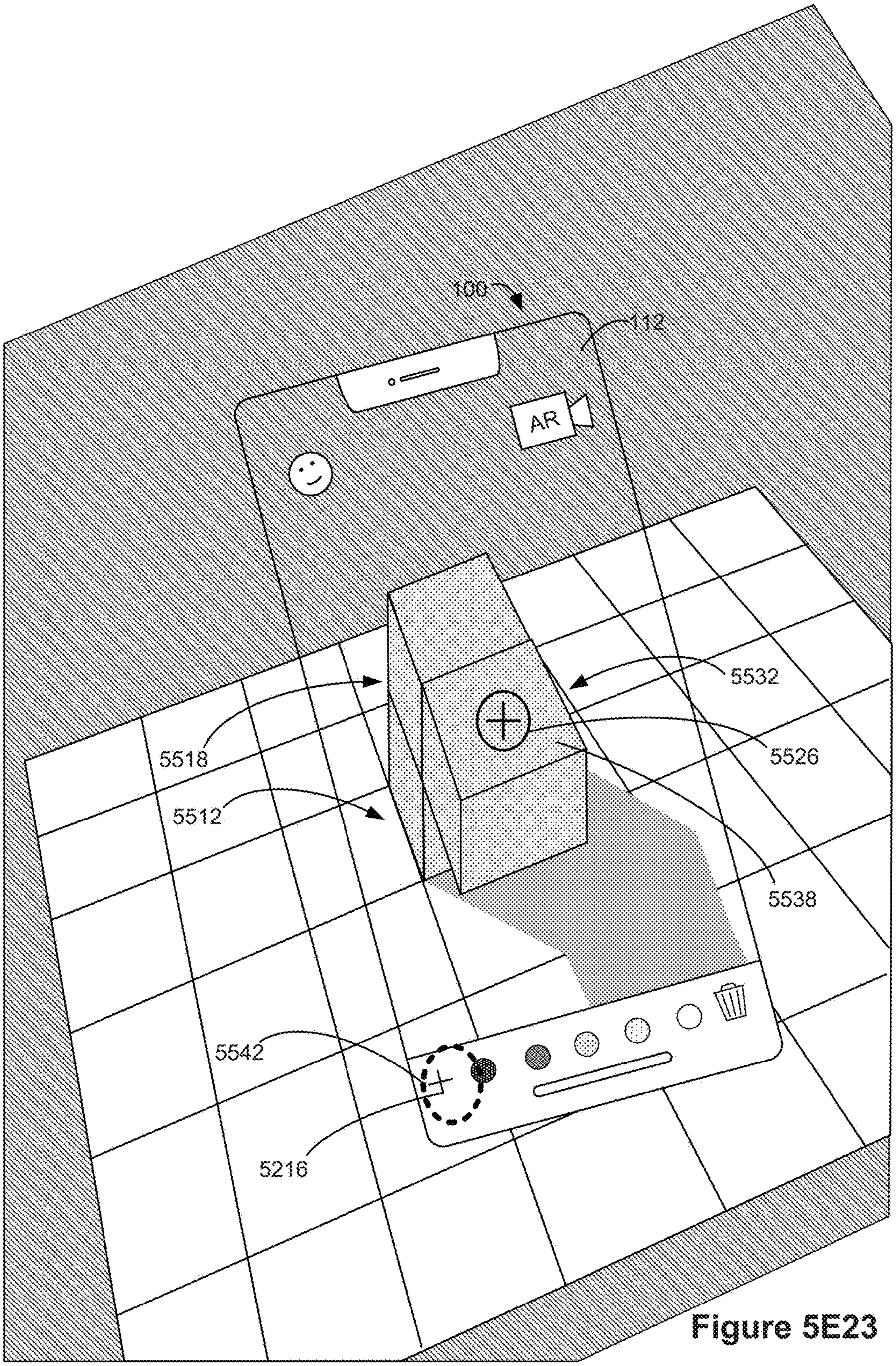

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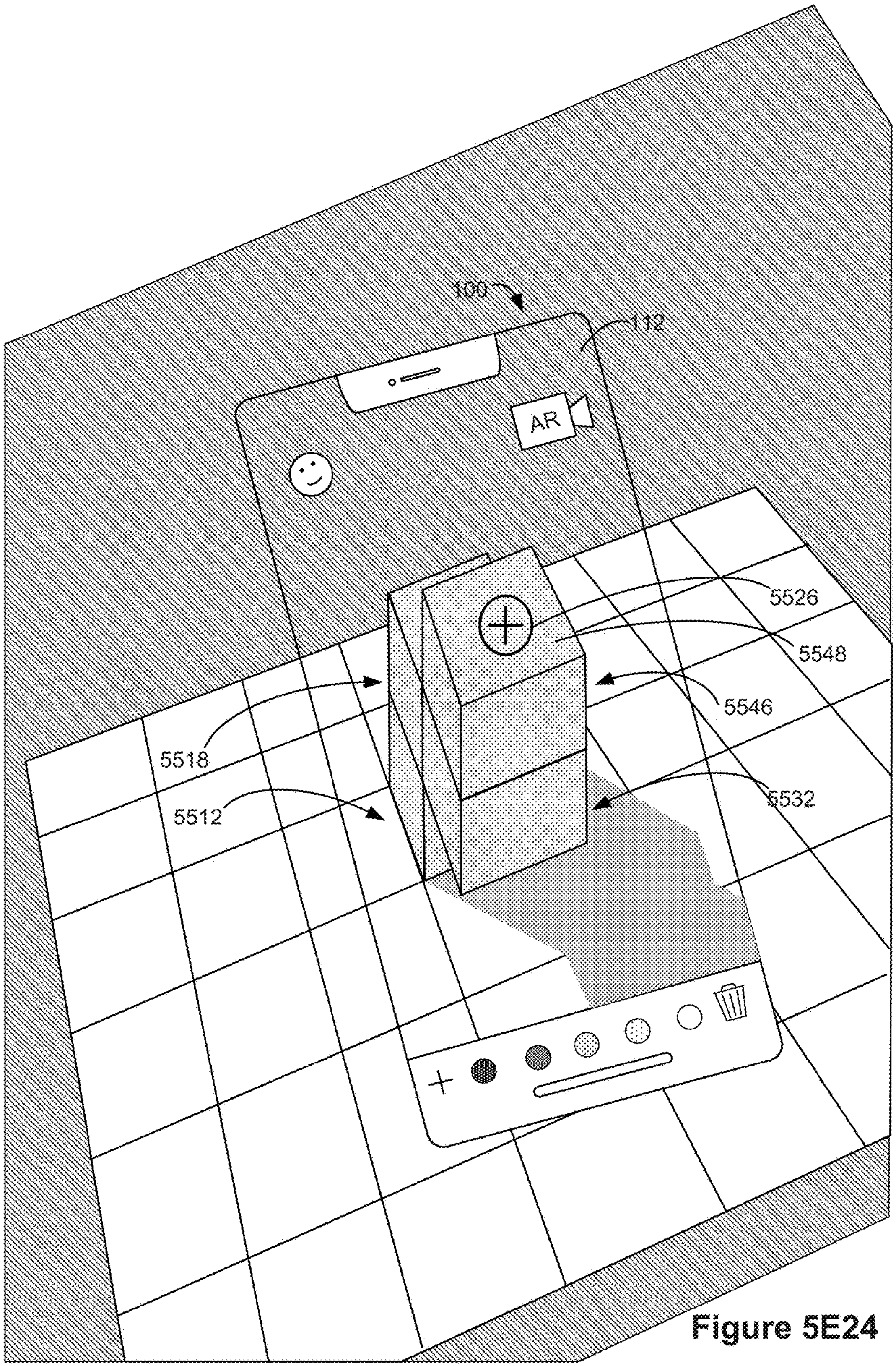

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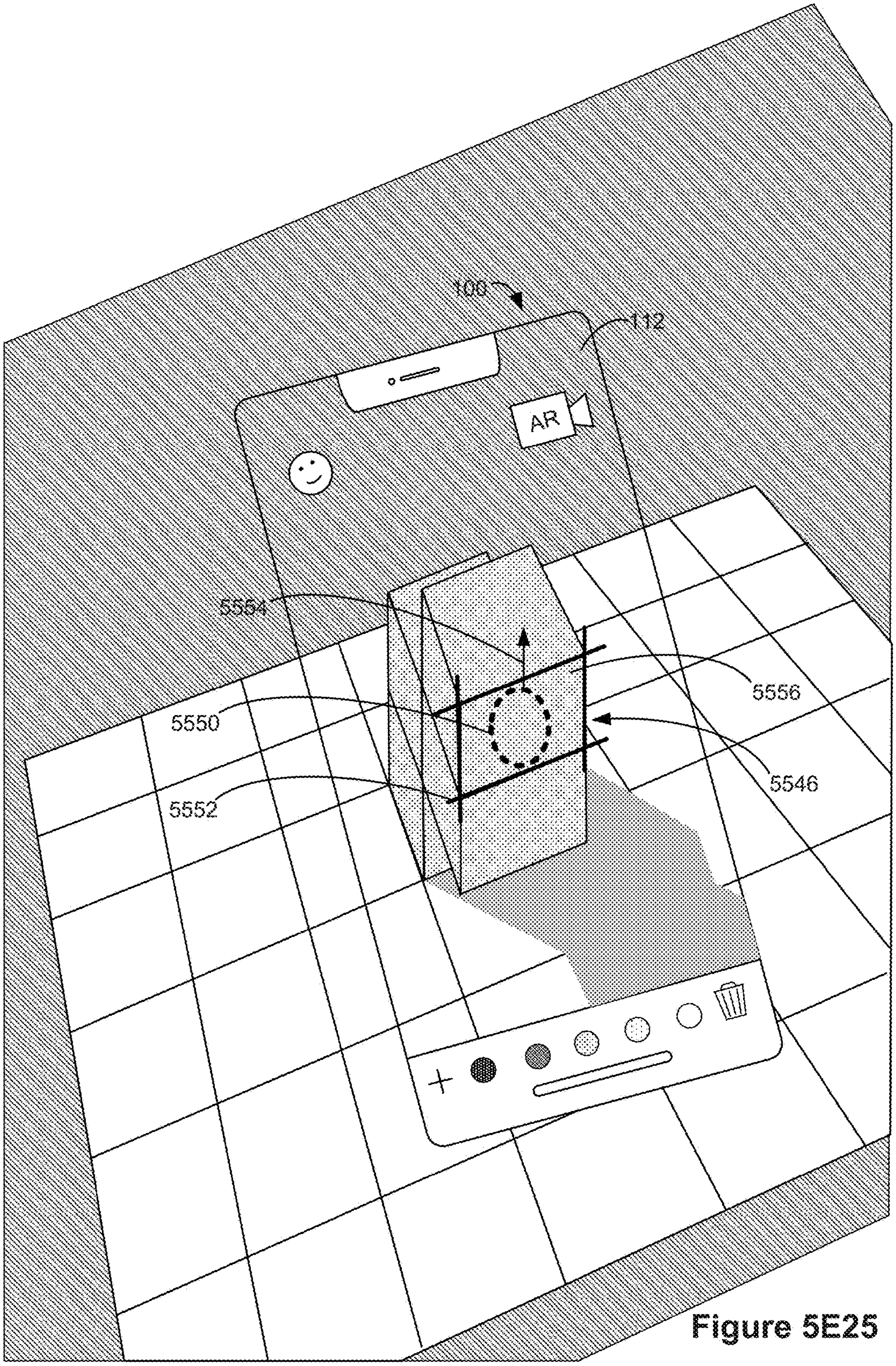

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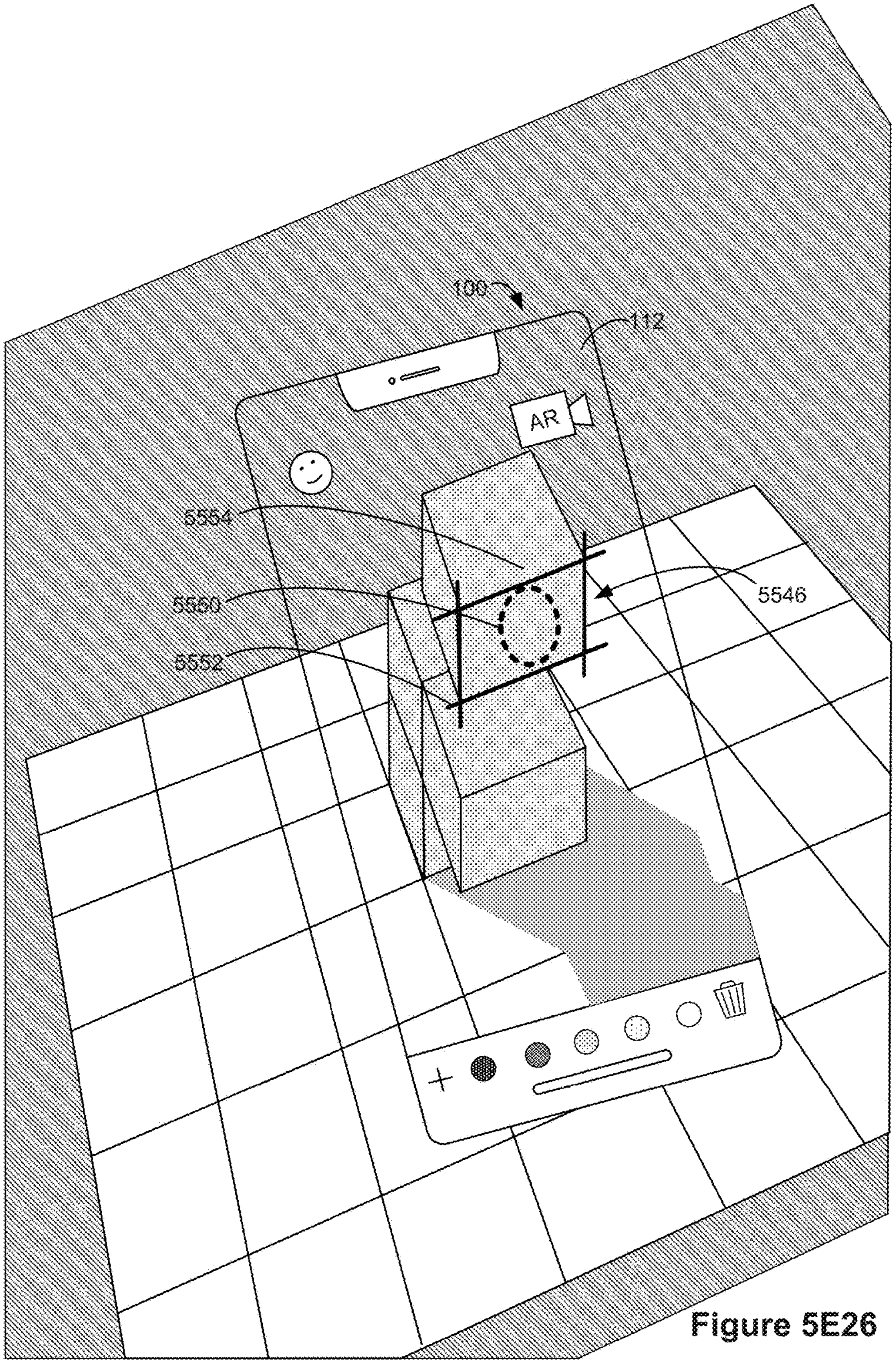

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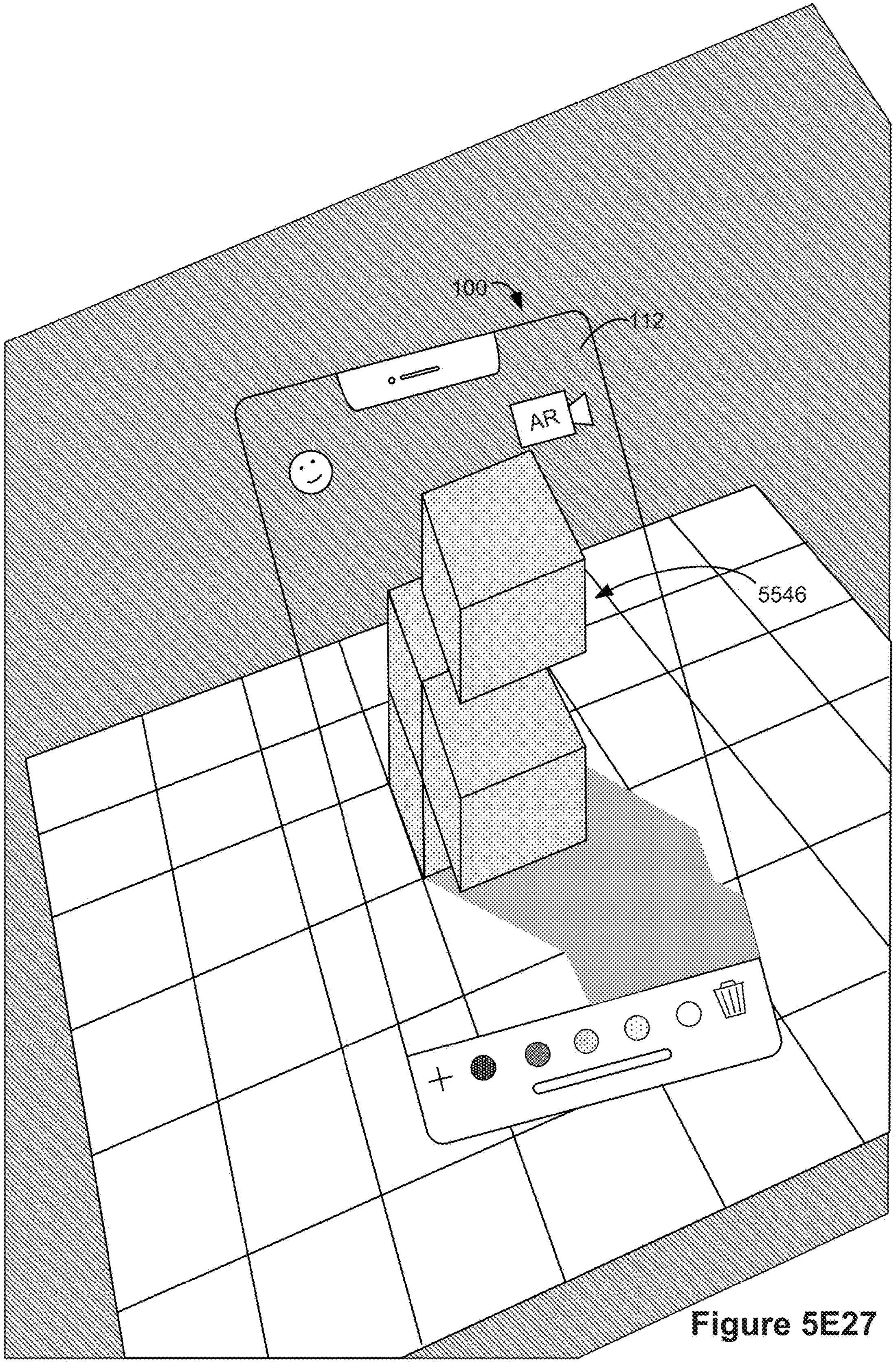

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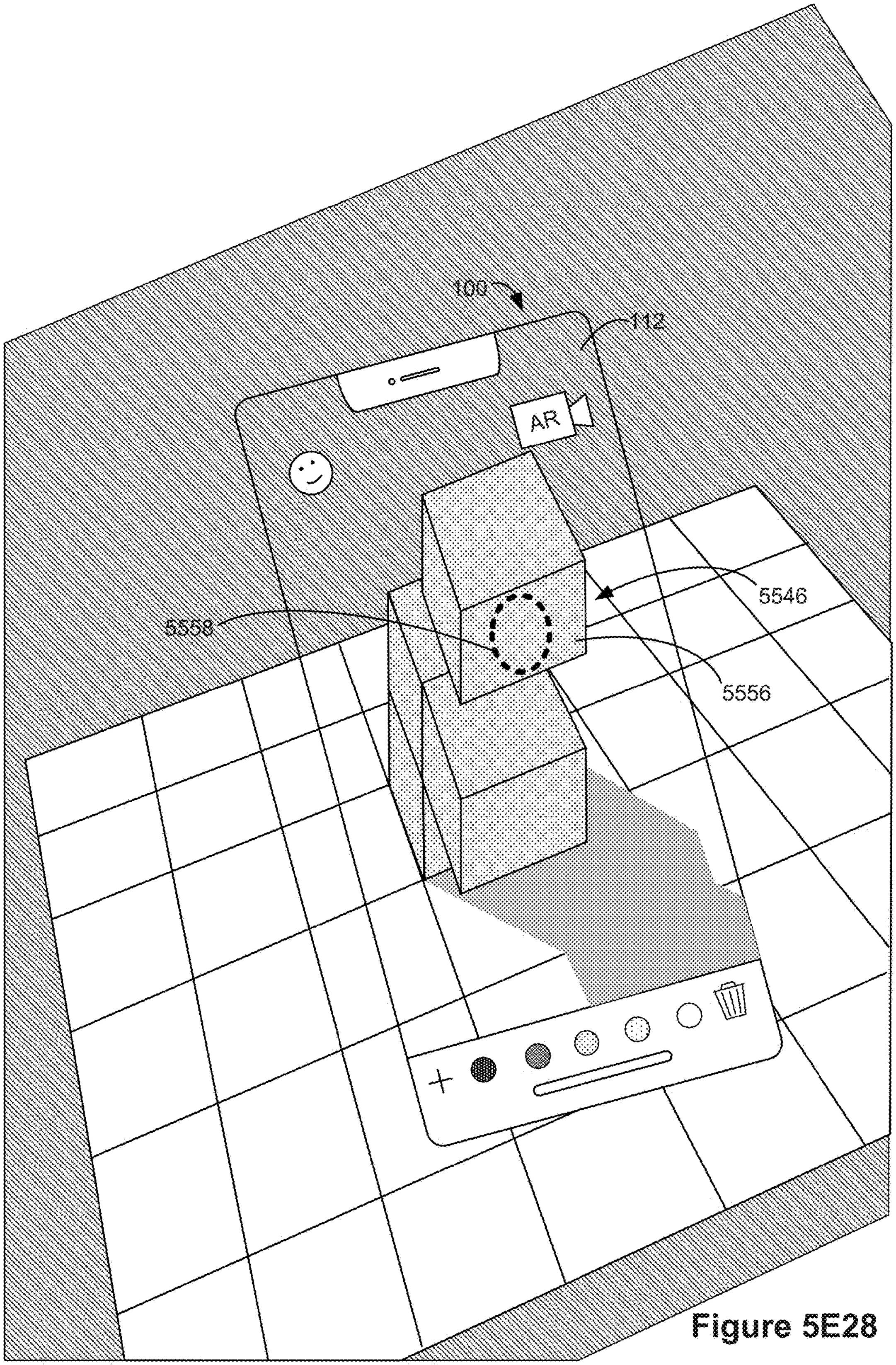

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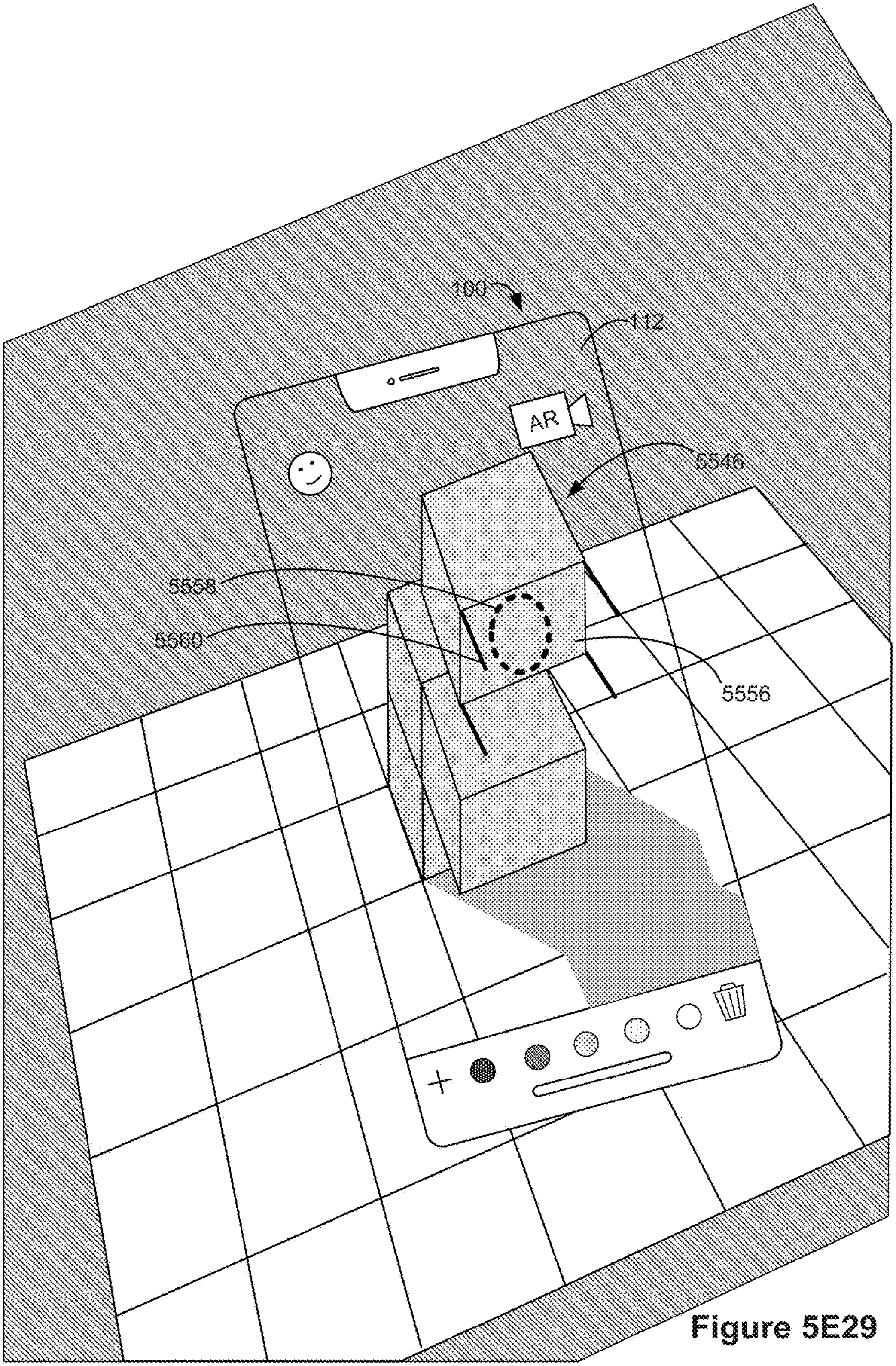

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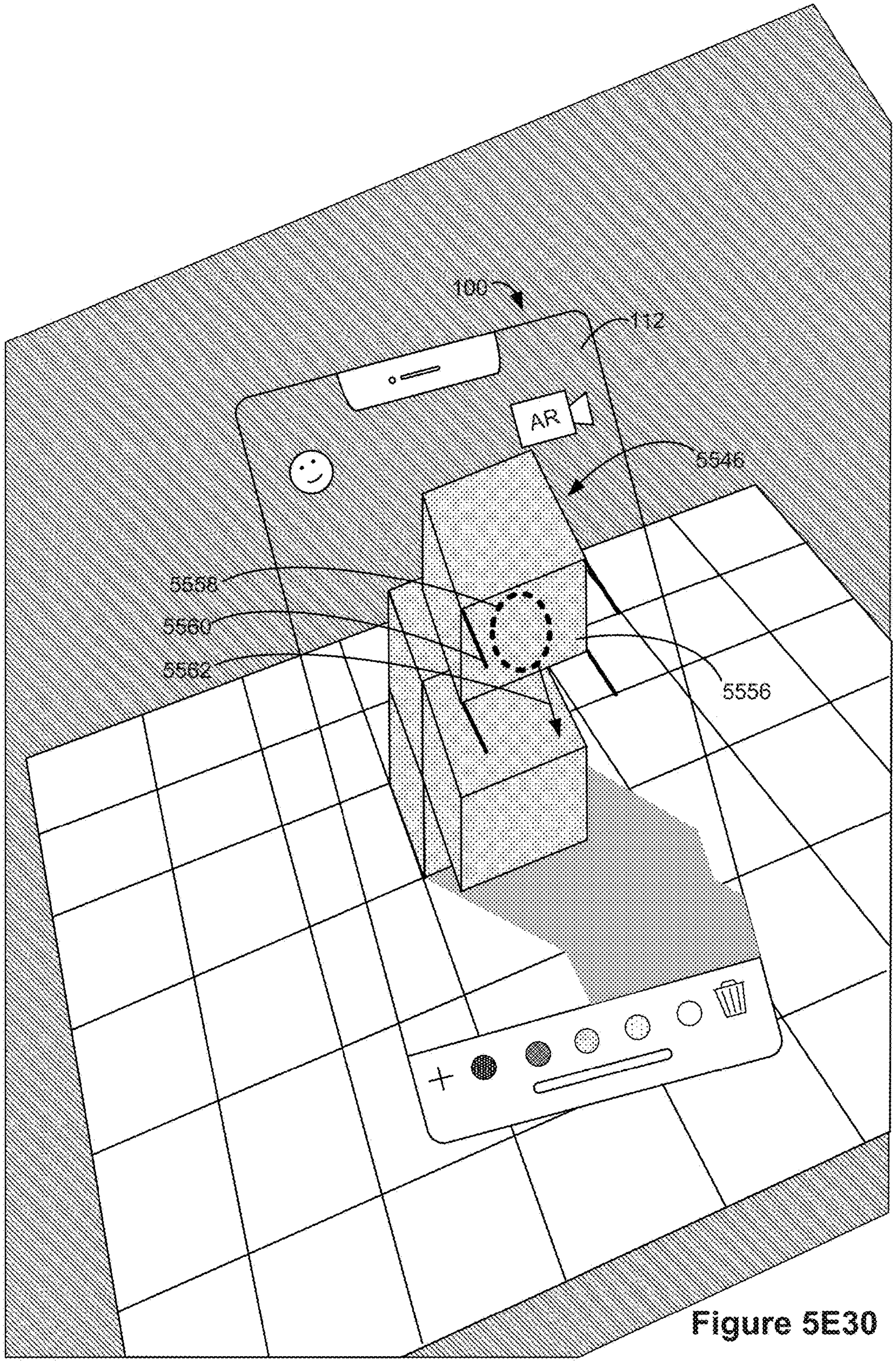
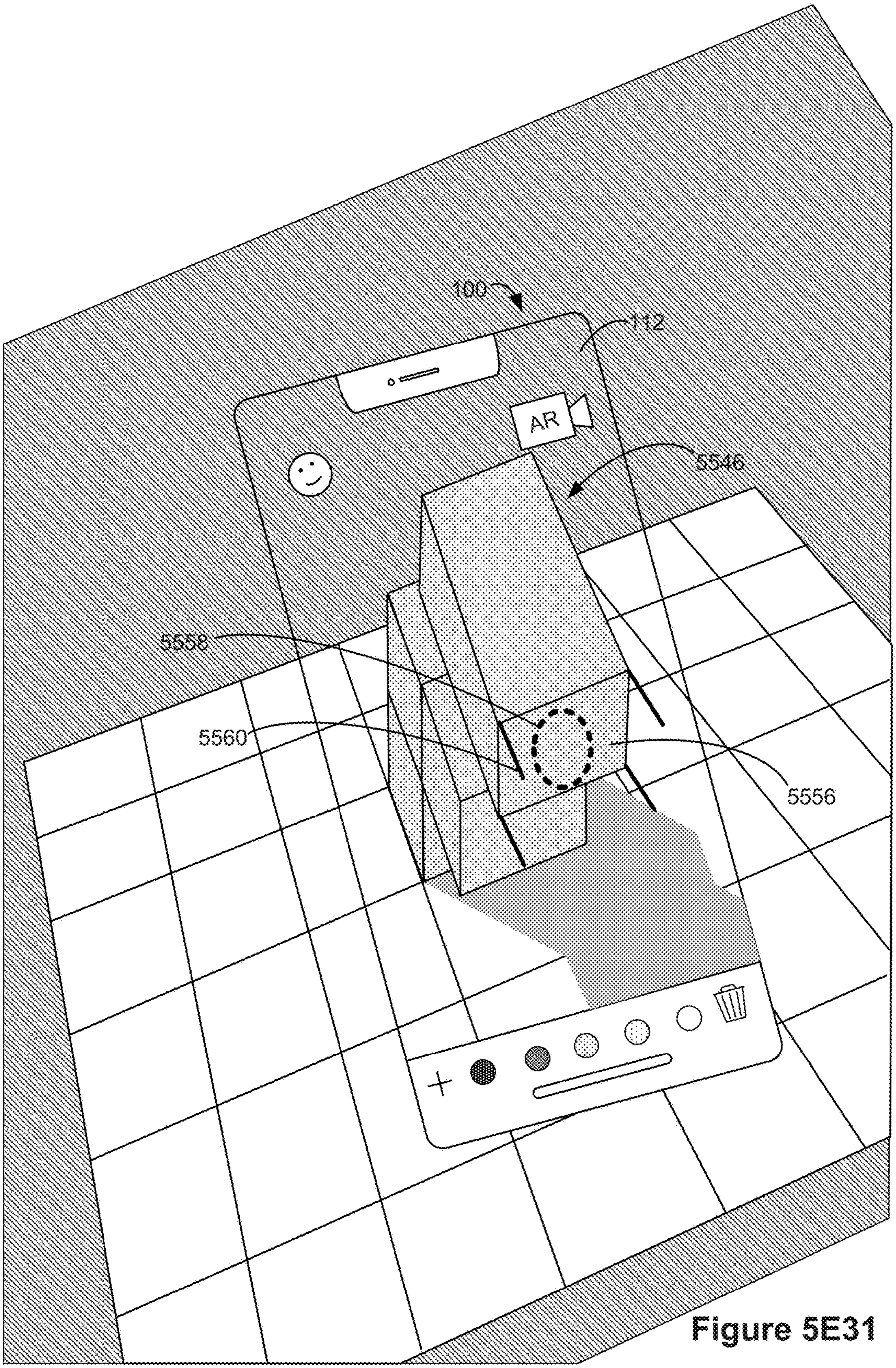


Figure 5E30



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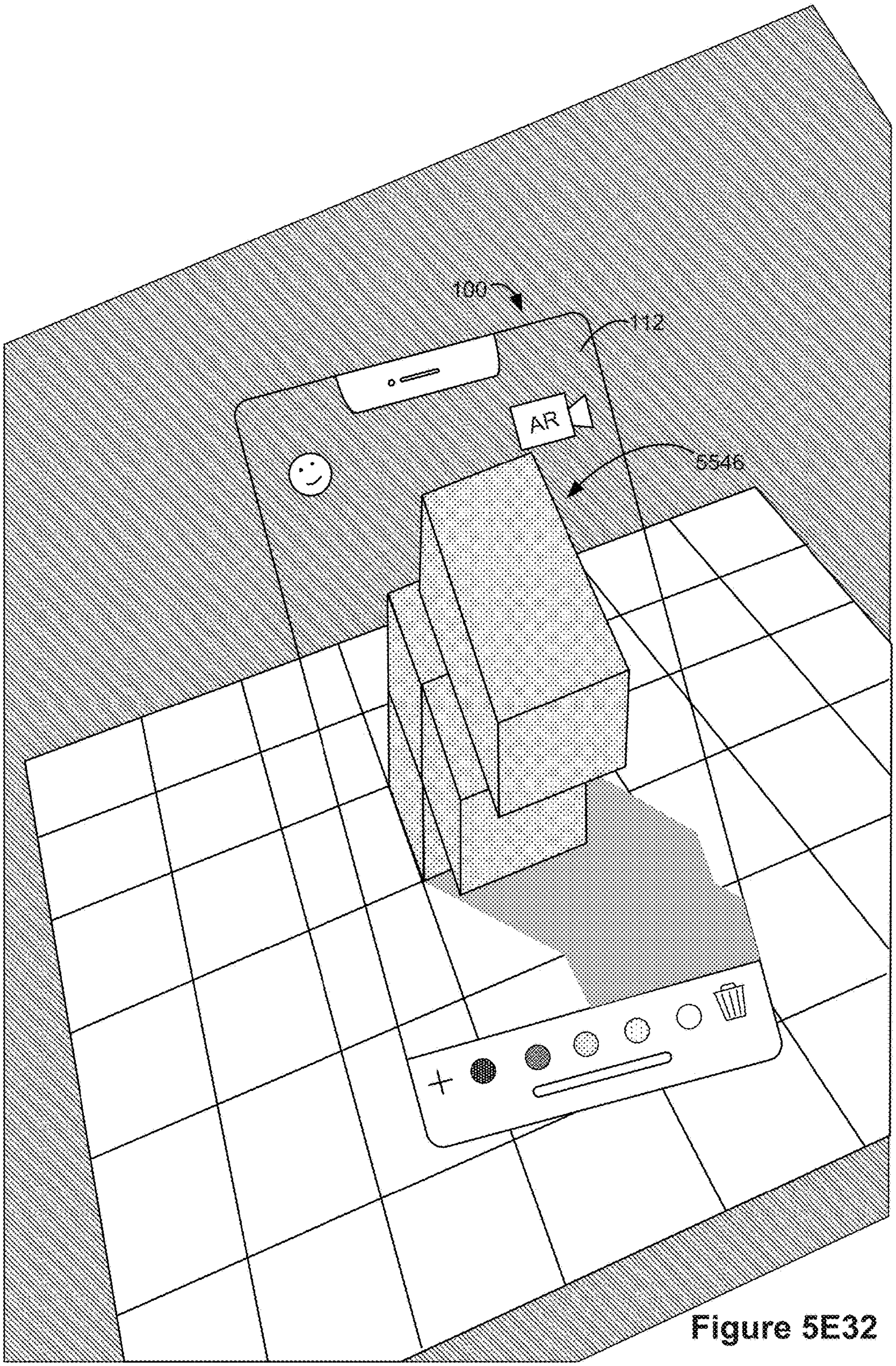

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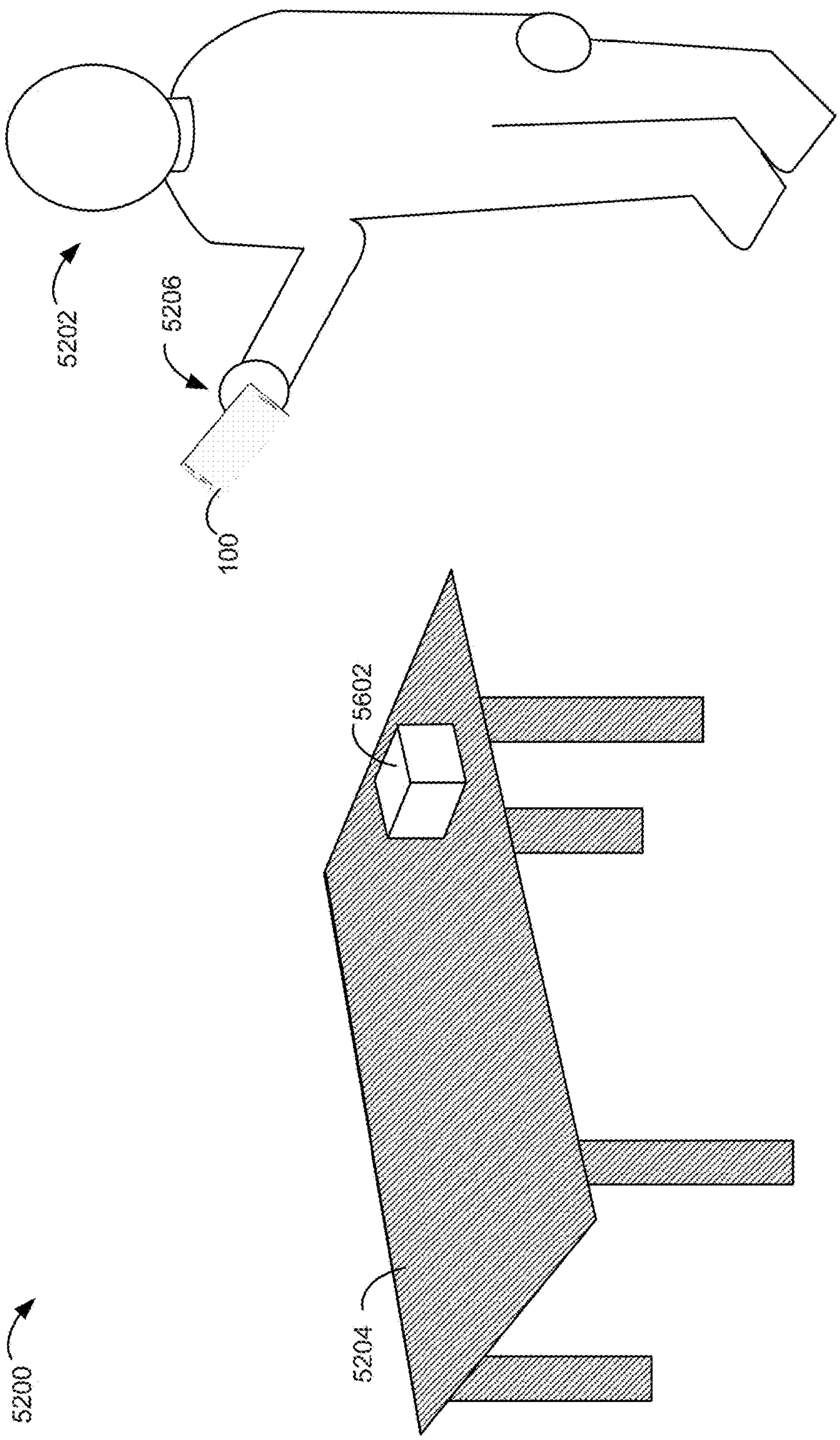

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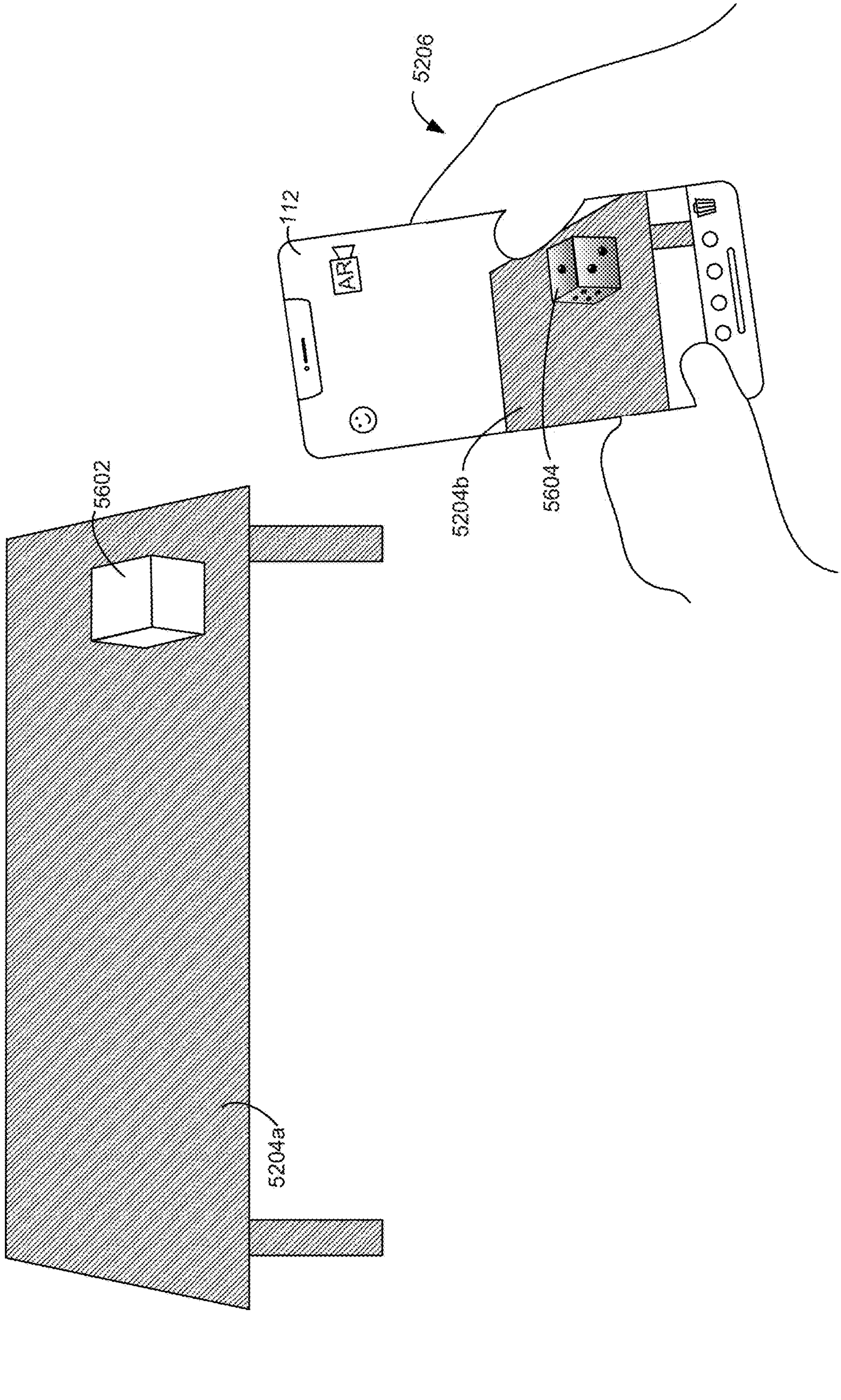

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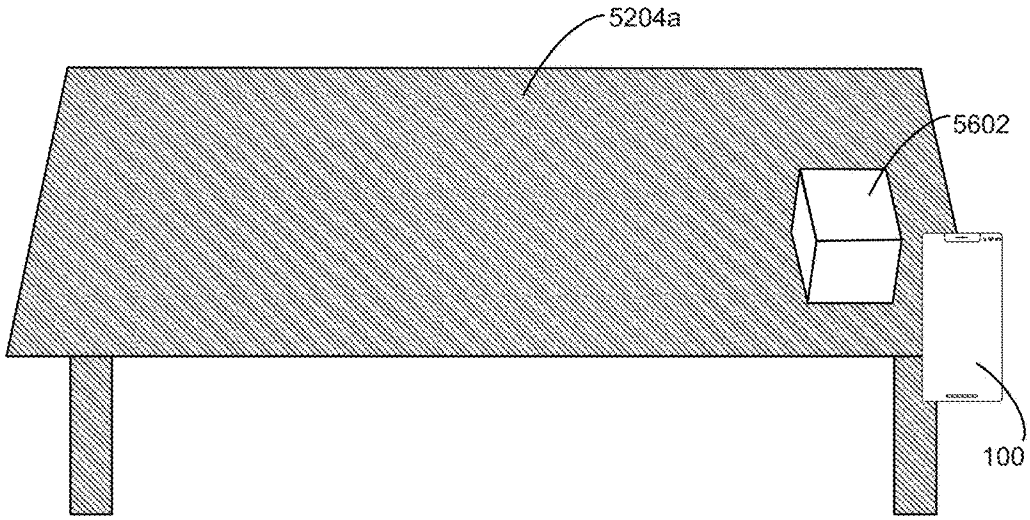

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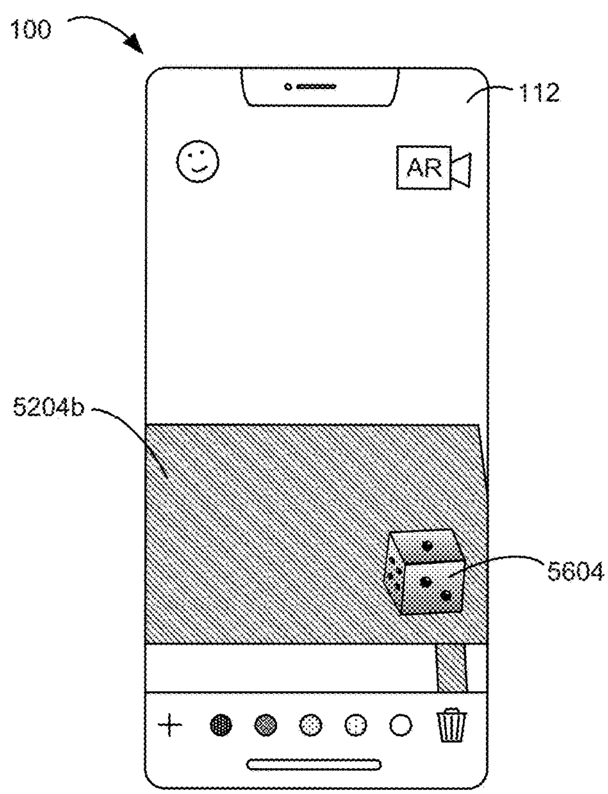
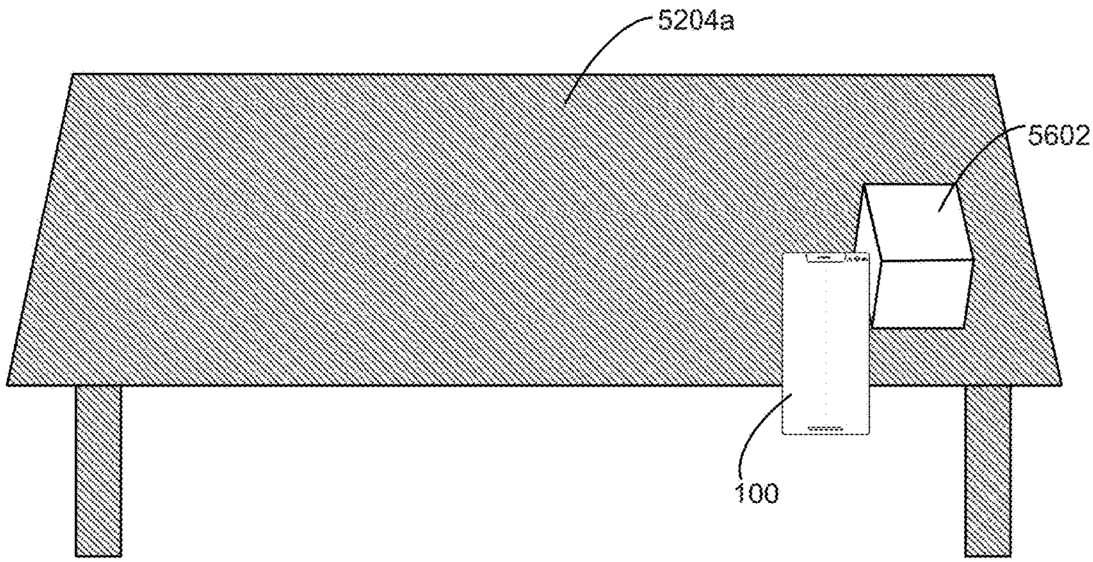


Figure 5F3b



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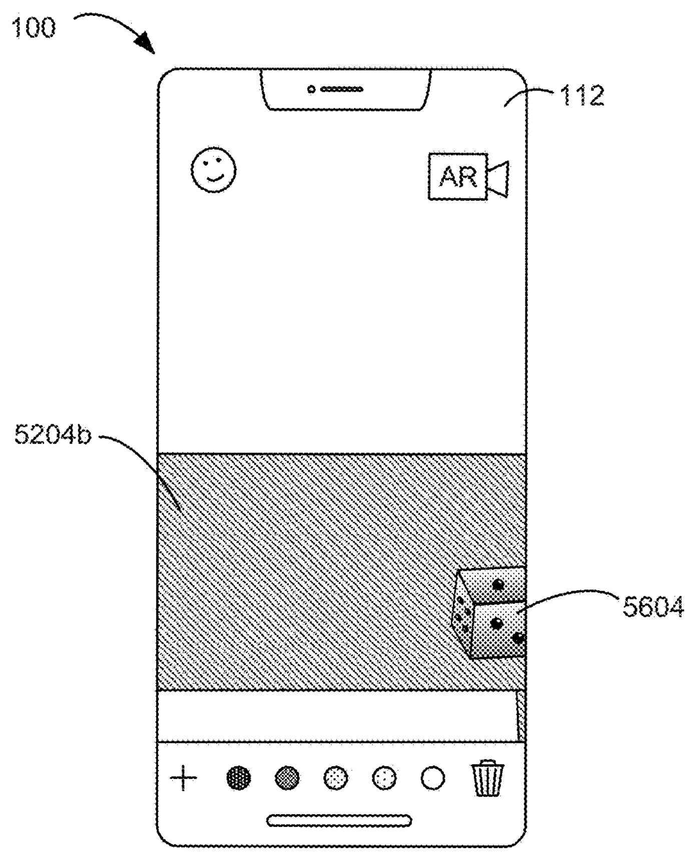

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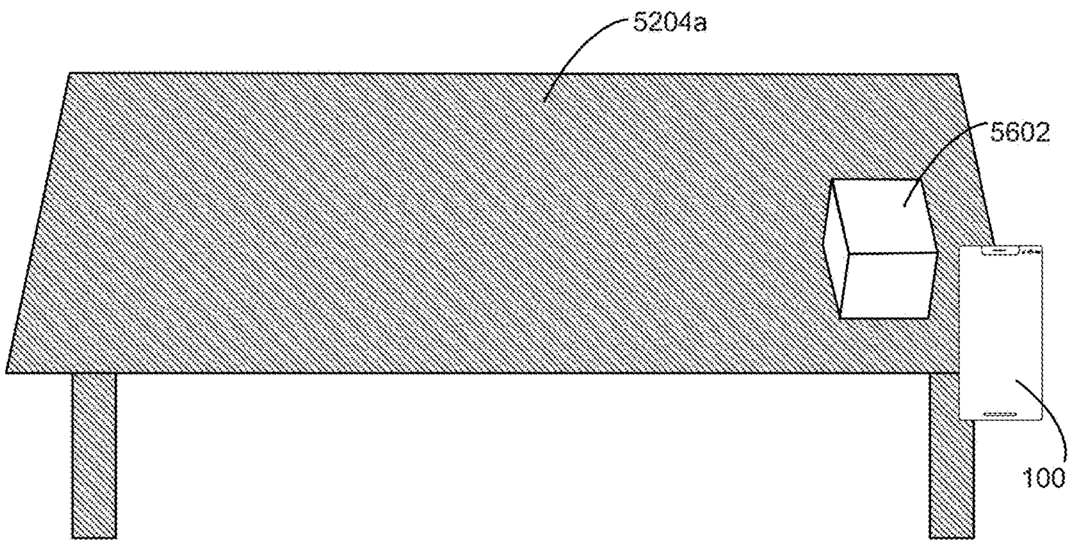

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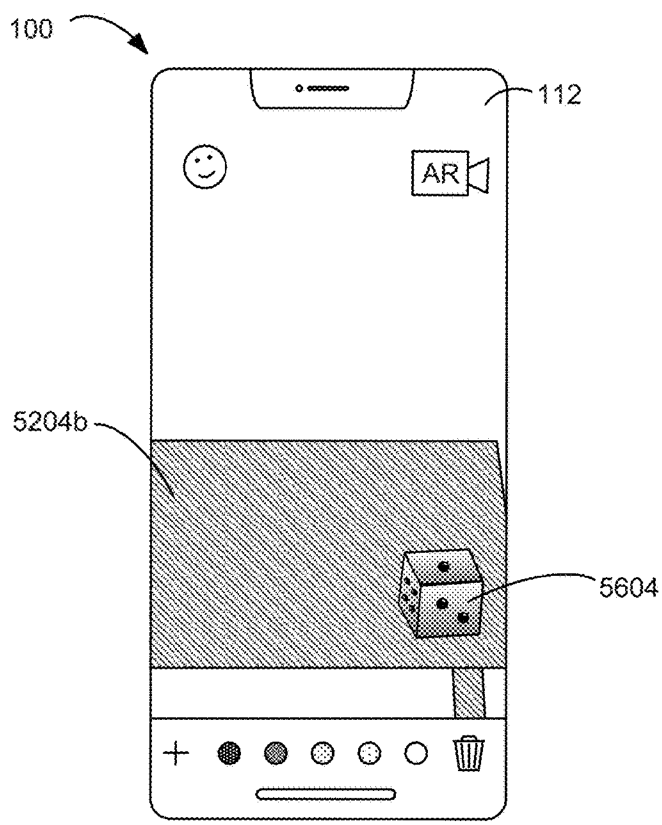

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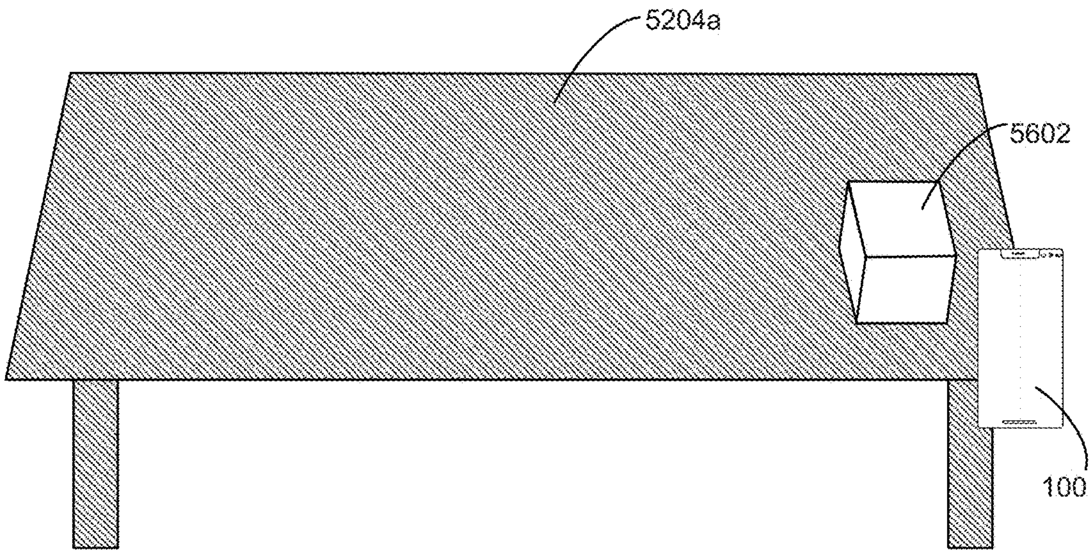

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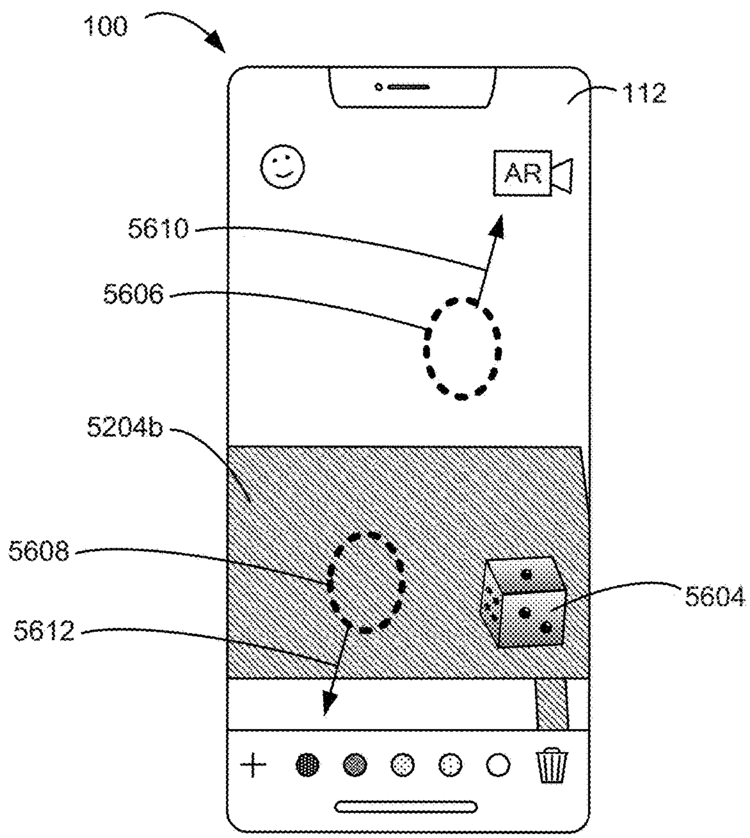

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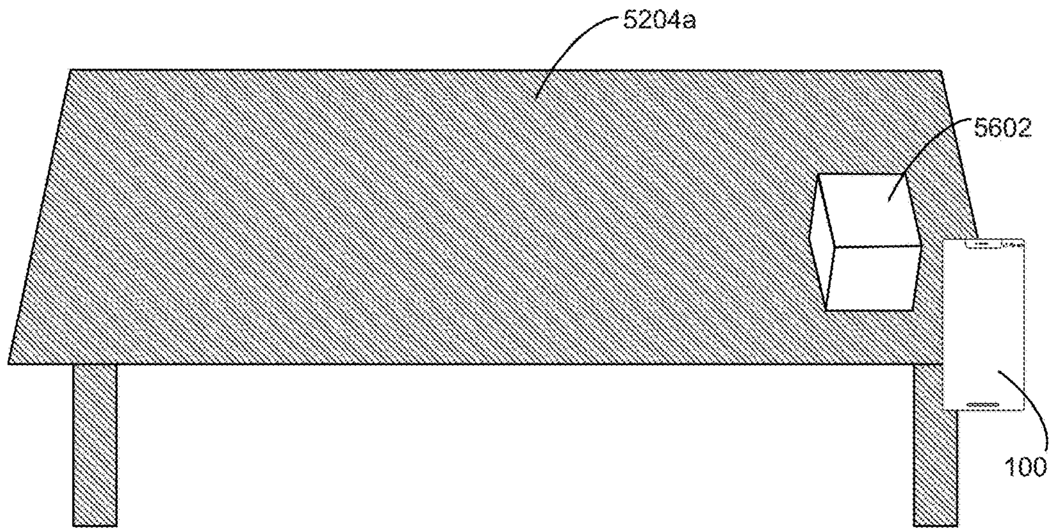

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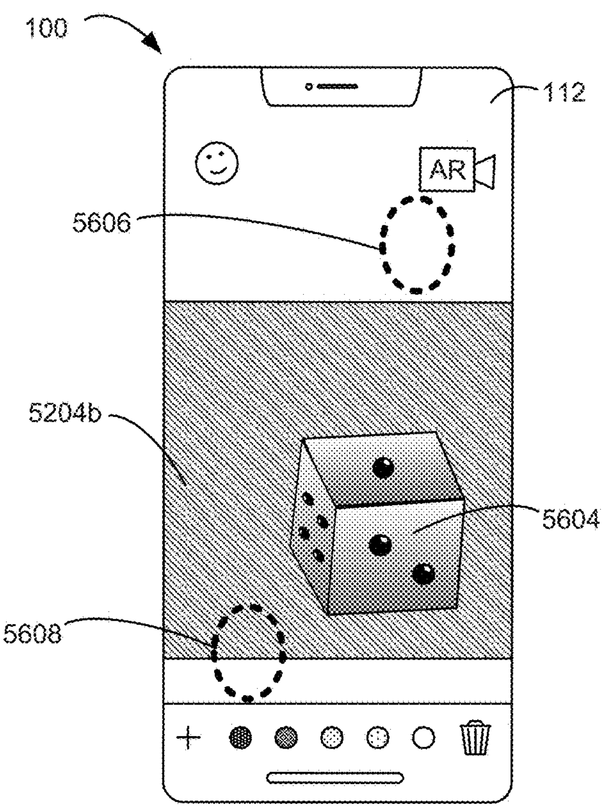

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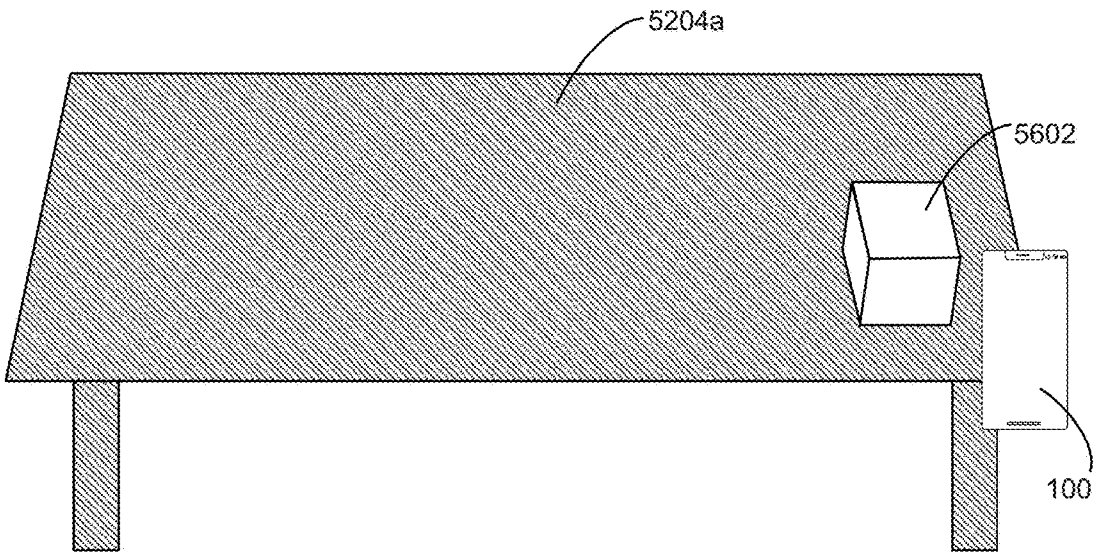

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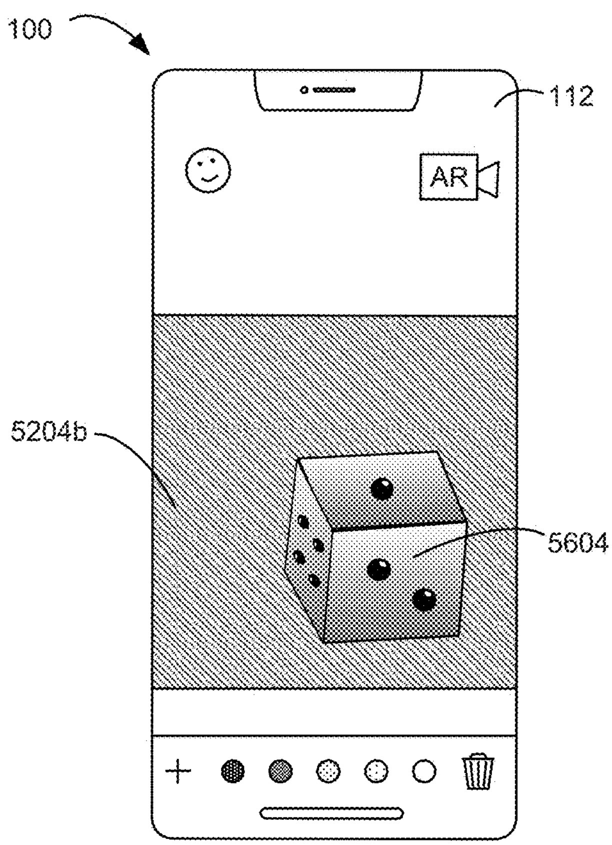

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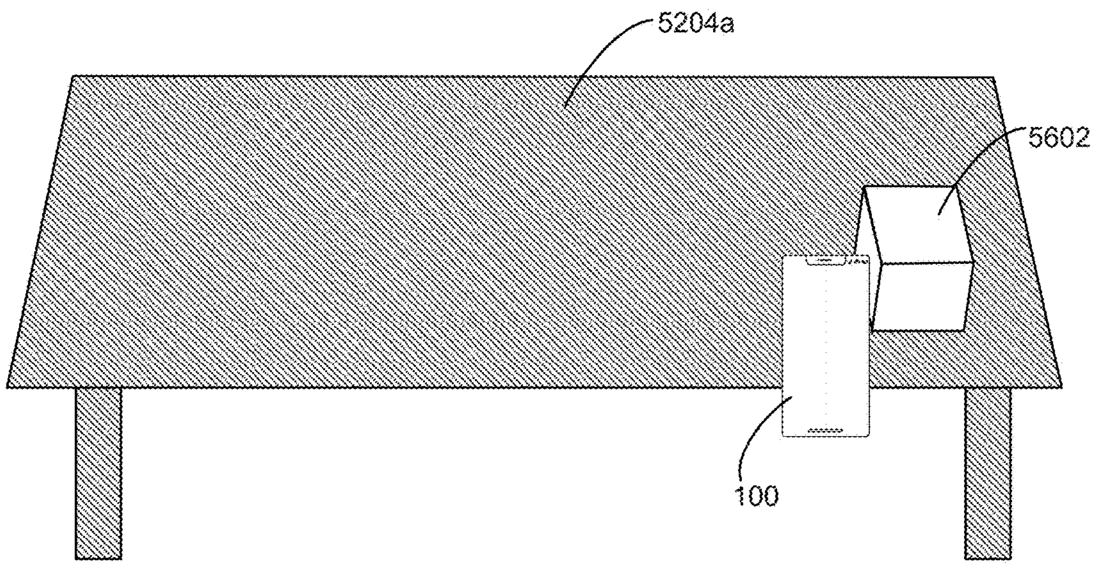

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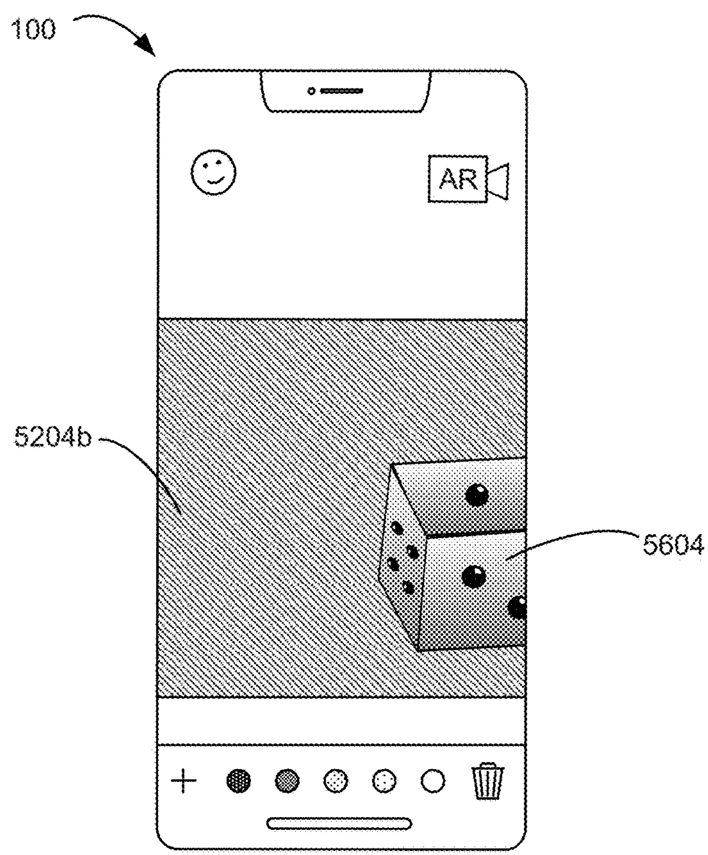
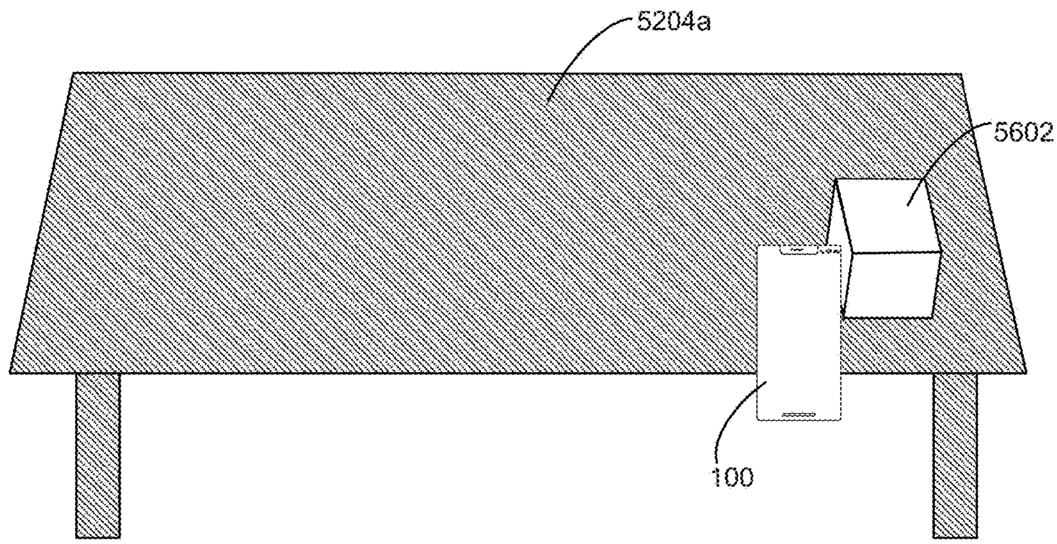


Figure 5F9b



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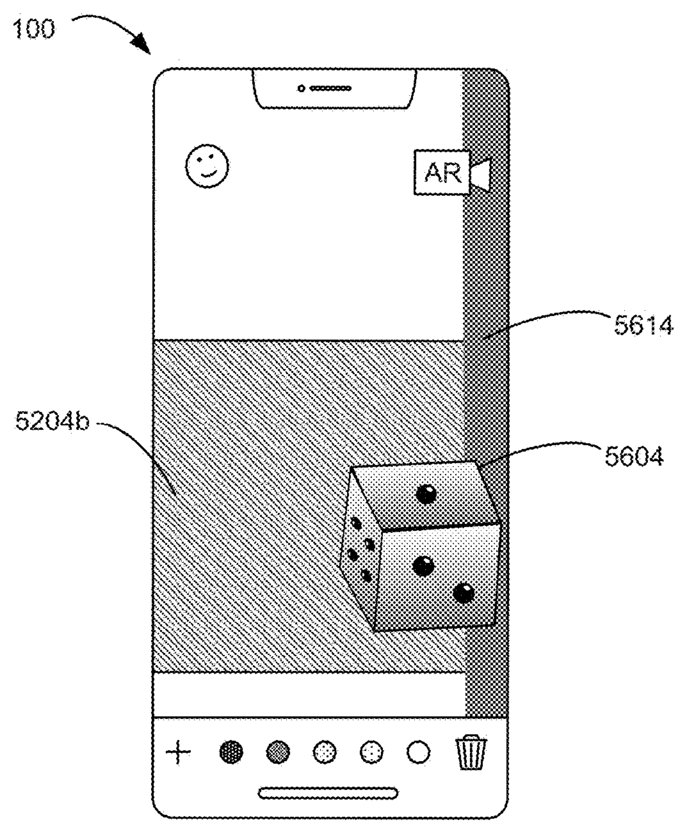

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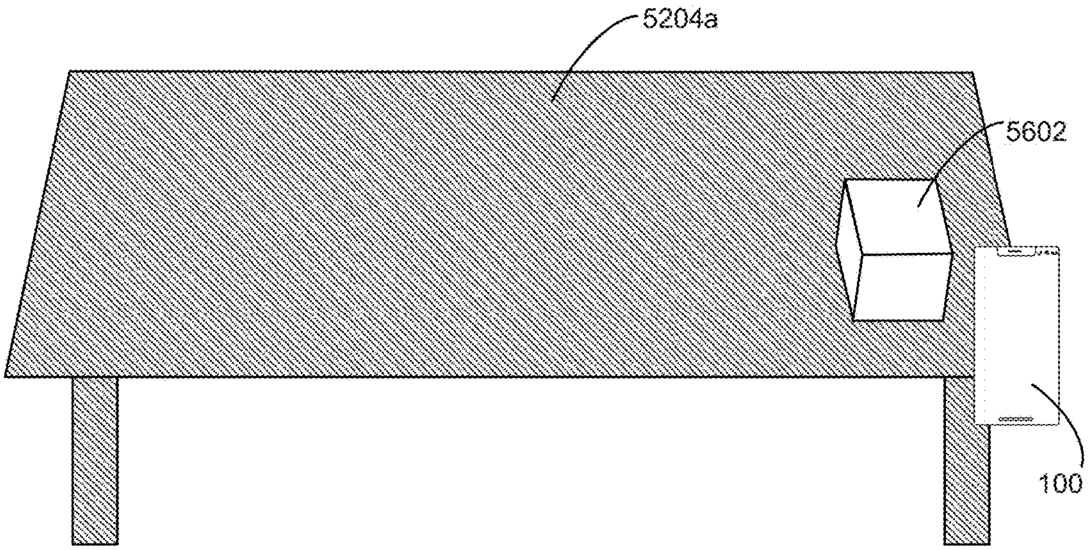

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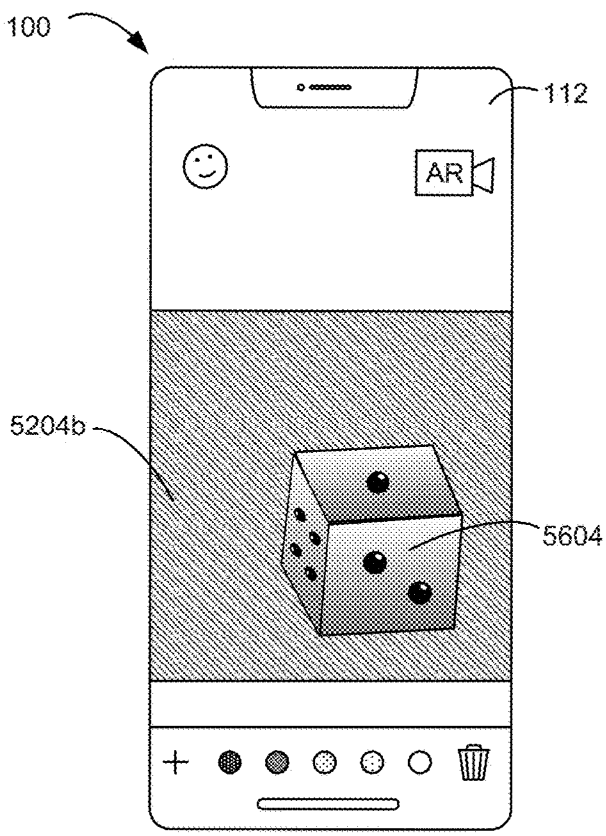

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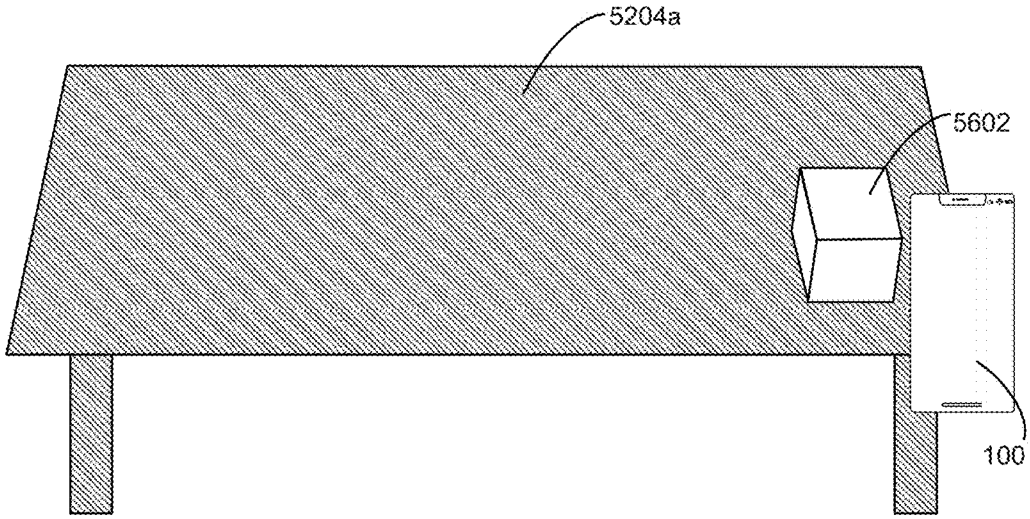

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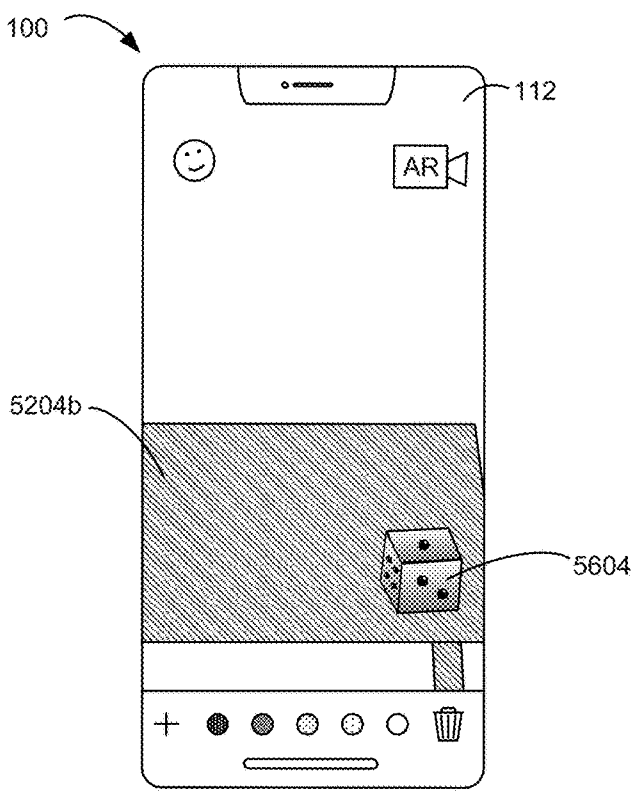

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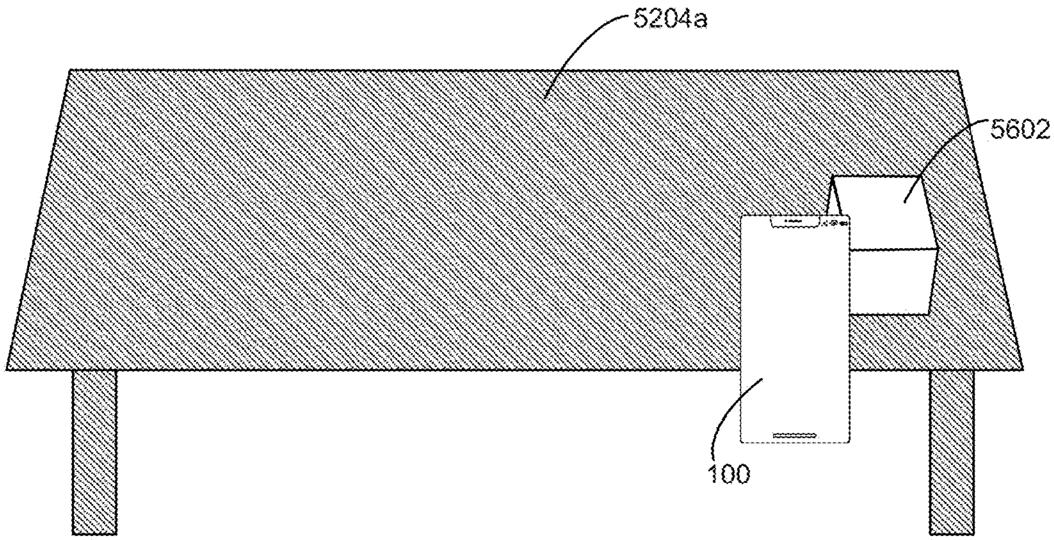

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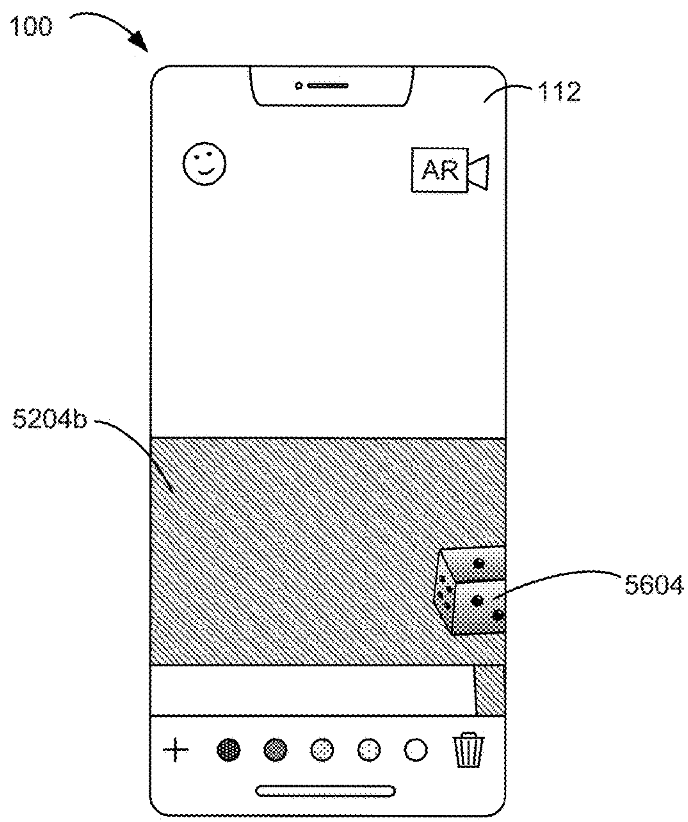

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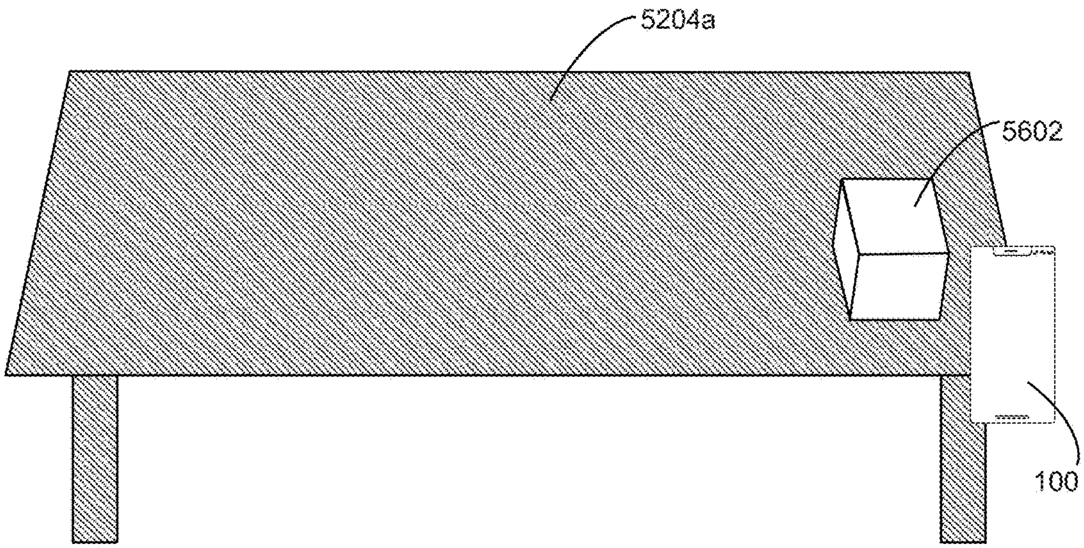

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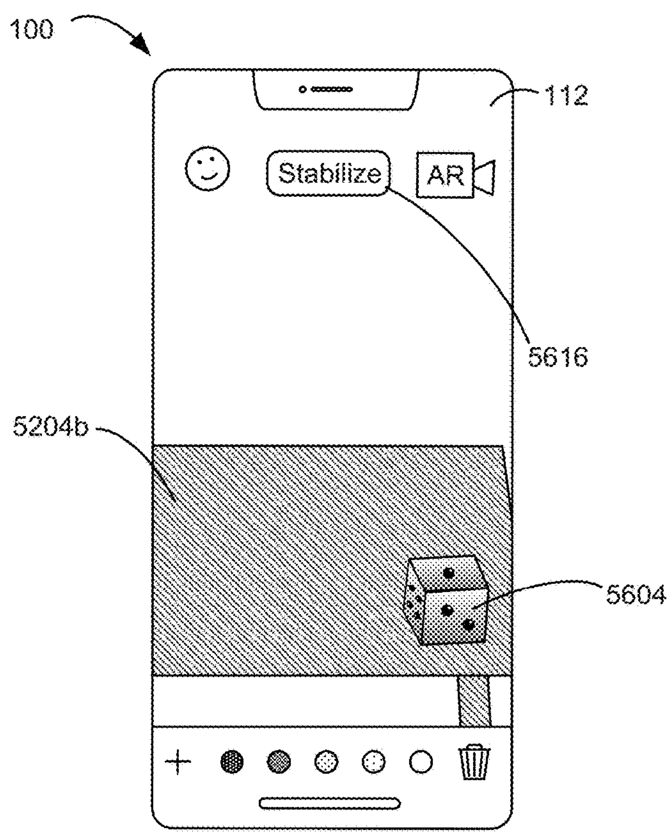

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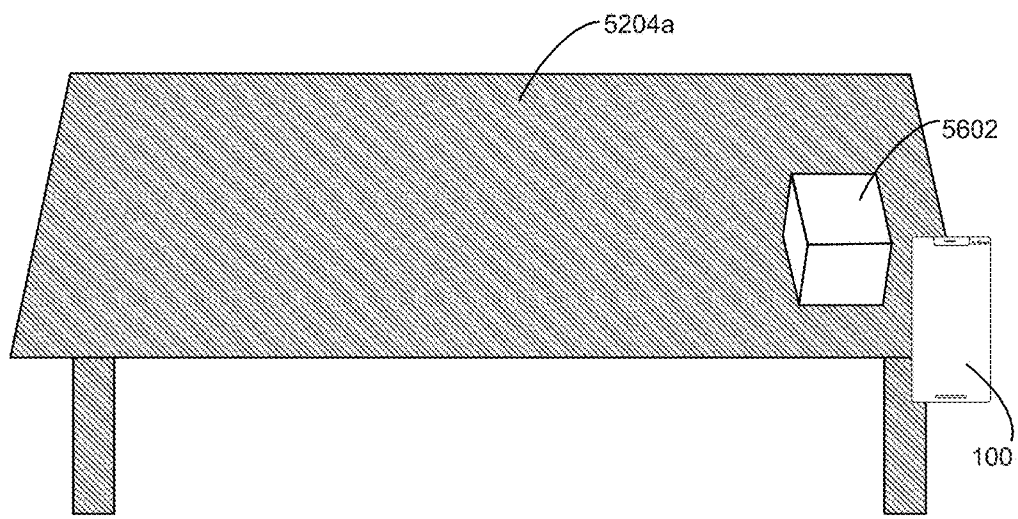

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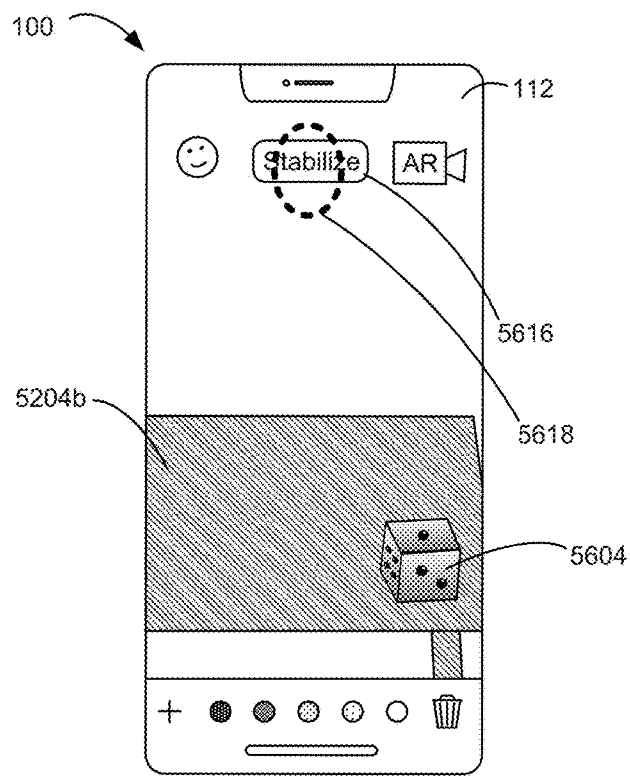

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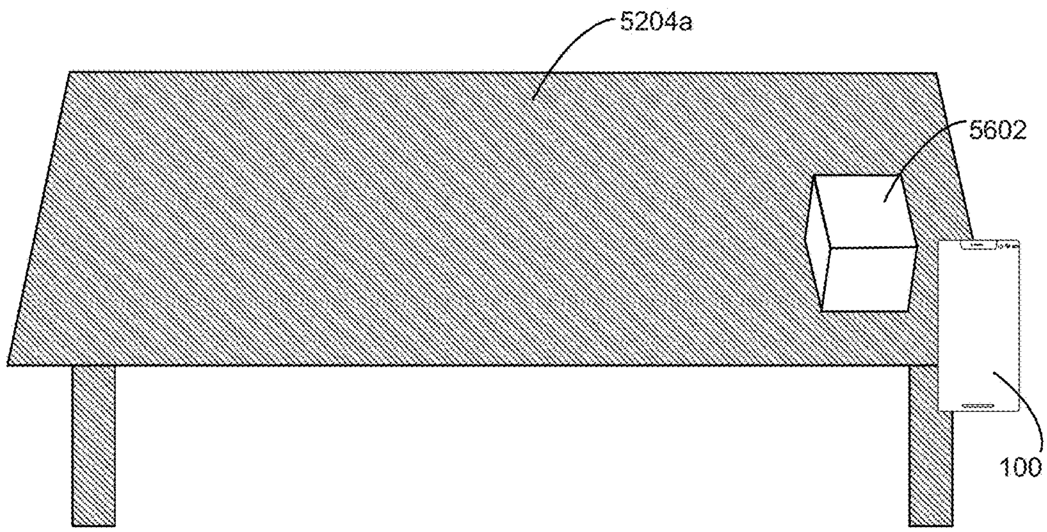

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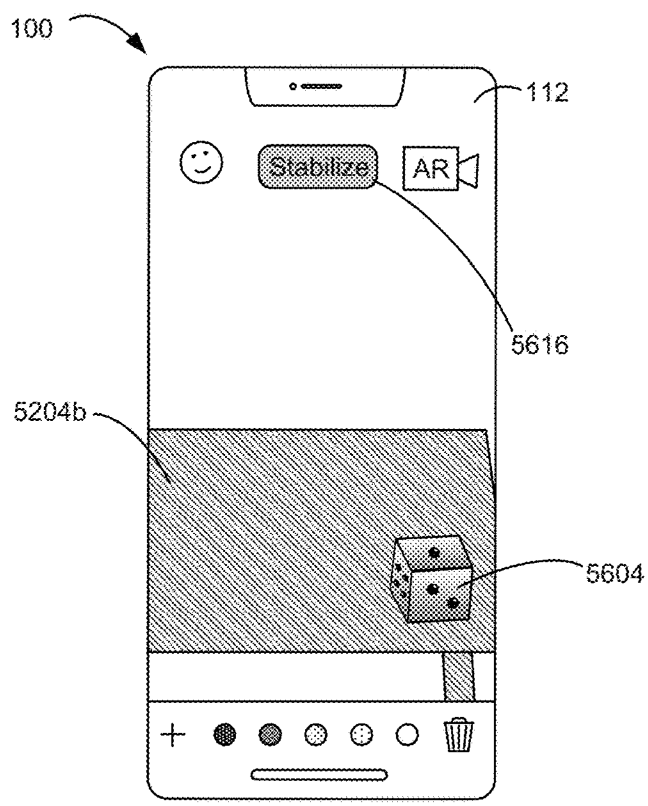

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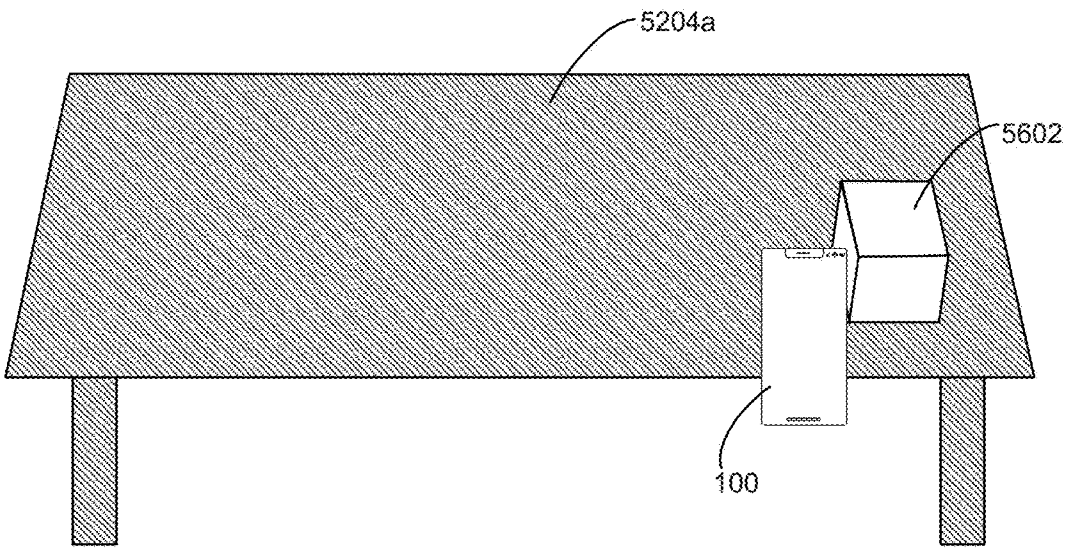

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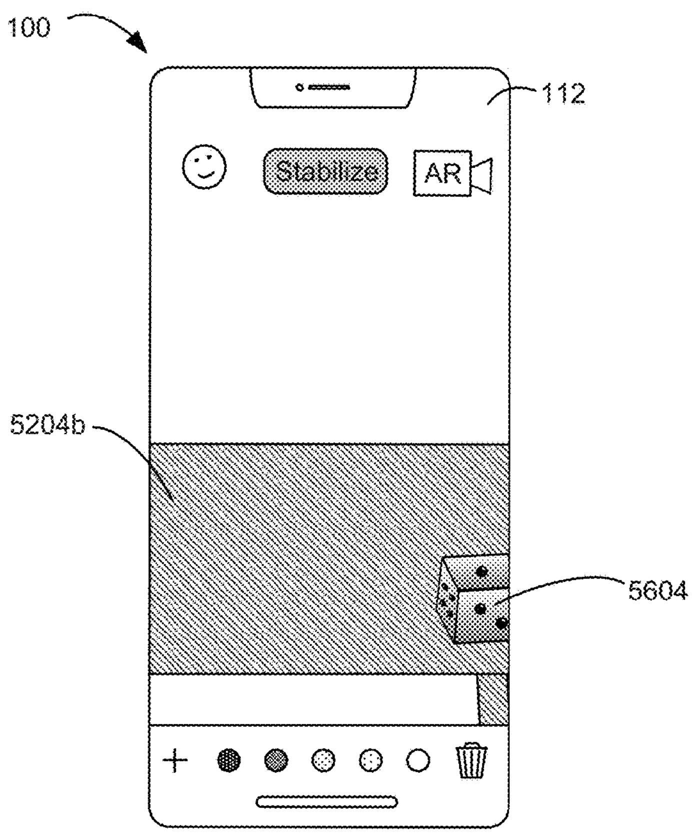

Figure 5F17b

600

602 Display, via the display generation component, an augmented reality environment

604 Displaying the augmented reality environment includes concurrently displaying:

a representation of at least a portion of a field of view of the one or more cameras that includes a respective physical object, wherein the representation is updated as contents of the field of view of the one or more cameras change; and

a respective virtual user interface object at a respective location in the representation of the field of view of the one or more cameras, wherein the respective virtual user interface object has a location that is determined based on the respective physical object in the field of view of the one or more cameras

606 While displaying the augmented reality environment, detect an input at a location that corresponds to the respective virtual user interface object

608 While continuing to detect the input:

detect movement of the input relative to the respective physical object in the field of view of the one or more cameras; and

in response to detecting the movement of the input relative to the respective physical object in the field of view of the one or more cameras, adjust an appearance of the respective virtual user interface object in accordance with a magnitude of movement of the input relative to the respective physical object

610 Adjusting the appearance of the respective virtual user interface object in accordance with the magnitude of movement of the input relative to the respective physical object includes:

in accordance with a determination that the magnitude of movement of the input relative to the respective physical object is a first magnitude, adjusting the appearance of the respective virtual user interface object by a first adjustment; and

in accordance with a determination that the magnitude of movement of the input relative to the respective physical object is a second magnitude distinct from the first magnitude, adjusting the appearance of the respective virtual user interface object by a second adjustment distinct from the first adjustment

Figure 6A

612 The respective virtual user interface object is anchored, before and after the adjusting, to the respective physical object in the field of view of the one or more cameras

614 The appearance of the respective virtual user interface object is adjusted in response to detecting the movement of the input relative to the respective physical object in the field of view of the one or more cameras without regard to whether the movement of the input is due to:
movement of the input on the input device,
movement of the one or more cameras relative to the respective physical object, or
a combination of the movement of the input on the input device and the movement of the one or more cameras relative to the respective physical object

616 The movement of the input relative to the respective physical object is based on
movement of the field of view of the one or more cameras relative to the respective physical object and
movement of the input on the input device

618 The movement of the input relative to the respective physical object is based on movement of the input on the input device, and the method includes:
after adjusting the appearance of the respective virtual user interface object in accordance with the magnitude of movement of the input relative to the respective physical object:
detecting movement of the field of view of the one or more cameras relative to the respective physical object; and
in response to detecting the movement of the field of view of the one or more cameras relative to the respective physical object, continuing to adjust the appearance of the respective virtual user interface object in accordance with a magnitude of movement of the field of view of the one or more cameras relative to the respective physical object

Figure 6B

620 The movement of the input relative to the respective physical object is based on movement of the field of view of the one or more cameras relative to the respective physical object, and the method includes:
after adjusting the appearance of the respective virtual user interface object in accordance with the magnitude of movement of the input relative to the respective physical object:
detecting movement of the input on the input device; and
in response to detecting the movement of the input on the input device, continuing to adjust the appearance of the respective virtual user interface object in accordance with a magnitude of movement of the input on the input device

622 Detecting the input at the location that corresponds to the respective virtual user interface object includes detecting the input at a first contact point on the respective virtual user interface object; and
the computer system updates the display of the respective virtual user interface object so as to maintain display of the first contact point on the respective virtual user interface object at a location that corresponds to a location of the input

624 Movement of the input relative to the respective physical object includes movement of the computer system; and
movement of the computer system is derived from image analysis that indicates one or more reference points within the field of view of the one or more cameras have changed between successive images captured by the one or more cameras

626 Adjusting the appearance of the respective virtual user interface object includes moving at least a portion of the respective virtual user interface object, wherein movement of the respective virtual user interface object is based on a physical shape of the respective physical object

628 Adjusting the appearance of the respective virtual user interface object includes moving at least a portion of the respective virtual user interface object, wherein movement of the respective virtual user interface object is based on concurrent movement of one or more touch inputs and movement of the computer system

Figure 6C

630 Adjusting the appearance of the respective virtual user interface object includes moving at least a portion of the respective virtual user interface object beyond a maximum limit of a resting state of the respective virtual user interface object, and the method includes:

while continuing to detect the input, displaying the respective virtual user interface object at a location beyond the maximum limit of the resting state of the respective virtual user interface object, in accordance with the magnitude of movement of the input relative to the respective physical object;

ceasing to detect the input; and

in response to ceasing to detect the input, displaying the respective virtual user interface object at a location corresponding to the maximum limit of the resting state of the respective virtual user interface object

632 The displayed augmented reality environment includes:

one or more virtual objects that do not correspond to physical objects in the field of view of the one or more cameras;

one or more physical objects that are in the field of view of the one or more cameras; and

one or more 3D virtual models of the one or more physical objects that are in the field of view of the one or more cameras that replace at least a portion of the corresponding one or more physical objects

634 The respective physical object is a 3D marker that is recognizable from different angles and the respective virtual user interface object is a 3D virtual model that is overlaid on the respective physical object based on a camera angle of the one or more cameras

Figure 6D

700

702 Display, via the display generation component, an augmented reality environment

704 Displaying the augmented reality environment includes concurrently displaying:

a representation of at least a portion of a field of view of the one or more cameras that includes a respective physical object, wherein the representation is updated as contents of the field of view of the one or more cameras change; and

a respective virtual user interface object at a respective location in the representation of the field of view of the one or more cameras, wherein the respective virtual user interface object has a location that is determined based on the respective physical object in the field of view of the one or more cameras

706 While displaying the augmented reality environment, detect an input that changes a virtual environment setting for the augmented reality environment

708 In response to detecting the input that changes the virtual environment setting:

adjust an appearance of the respective virtual user interface object in accordance with the change made to the virtual environment setting for the augmented reality environment; and

apply a filter to at least a portion of the representation of the field of view of the one or more cameras, wherein the filter is selected based on the change made to the virtual environment setting

710 Applying the filter to at least a portion of the representation of the field of view of the one or more cameras causes an appearance adjustment of the augmented reality environment that is in addition to the appearance adjustment of the respective virtual user interface object

Figure 7A

712 The virtual environment setting is changed to a night mode; and
applying the filter to at least a portion of the representation of the field of view of the one or more cameras includes:
decreasing brightness of an image captured by the one or more cameras; and
applying a color filter to the image captured by the one or more cameras

714 The input that changes the virtual environment setting is a swipe input that navigates through time in the augmented reality environment

716 Detecting the input that changes the virtual environment setting includes detecting a movement of the input to change the virtual environment setting;
adjusting the appearance of the respective virtual user interface object in accordance with the change made to the virtual environment setting for the augmented reality environment includes gradually adjusting the appearance of the respective virtual user interface object in accordance with the movement of the input to change the virtual environment setting; and
applying the filter to at least a portion of the representation of the field of view of the one or more cameras includes gradually applying the filter in accordance with the movement of the input to change the virtual environment setting

718 The respective virtual user interface object casts a shadow on the respective physical object in the augmented reality environment

720 The respective physical object casts a shadow on the respective virtual user interface object in the augmented reality environment

722 Movement of the respective physical object causes one or more changes in the appearance of the respective virtual user interface object in the augmented reality environment

724 Movement of the computer system causes one or more changes in a visual effect that is applied to the representation of at least a portion of the field of view of the one or more cameras and the appearance of the respective virtual user interface object

Figure 7B

726 Applying the filter to at least a portion of the representation of the field of view of the one or more cameras includes:
applying the filter to an image captured by the one or more cameras before the image is transmitted to the display generation component

728 The input that changes the virtual environment setting is an input that switches between different virtual environments for the virtual user interface object, wherein different virtual environments are associated with different interactions for exploring the virtual user interface object

730 In accordance with a determination that a first virtual environment setting is selected, display a first set of virtual objects in the augmented reality environment; and
in accordance with a determination that a second virtual environment setting is selected, display a second set of virtual objects, distinct from the first set of virtual objects, in the augmented reality environment

Figure 7C

800

802 Display, via the display generation component, an augmented reality environment

804 Displaying the augmented reality environment includes concurrently displaying:
a representation of at least a portion of a field of view of the one or more cameras that includes a respective physical object, wherein the representation is updated as contents of the field of view of the one or more cameras change; and
a first virtual user interface object in a virtual model that is displayed at a respective location in the representation of the field of view of the one or more cameras, wherein the first virtual user interface object has a location that is determined based on the respective physical object in the field of view of the one or more cameras

806 While displaying the augmented reality environment, detect a first input that corresponds to selection of the first virtual user interface object

808 In response to detecting the first input that corresponds to selection of the first virtual user interface object:
display a simulated field of view of the virtual model from a perspective of the first virtual user interface object in the virtual model

810 In response to detecting the first input that corresponds to selection of the first virtual user interface object, cease to display the representation of the field of view of the one or more cameras

812 In response to detecting movement of at least a portion of the computer system that changes the field of view of the one or more cameras while displaying the augmented reality environment, update the representation of the field of view of the one or more cameras

Figure 8A

814 While displaying the augmented reality environment, in response to detecting movement of at least a portion of the computer system that changes a perspective of the contents of the field of view of the one or more cameras, update the representation of the field of view of the one or more cameras and the virtual model in accordance with the changes in the perspective of the contents of the field of view

816 In response to detecting the first input that corresponds to selection of the first virtual user interface object, display an animated transition from the augmented reality environment to the simulated field of view of the virtual model from the perspective of the first virtual user interface object in the virtual model

818 While displaying the simulated field of view of the virtual model from the perspective of the first virtual user interface object in the virtual model, detect a second input that corresponds to a request to display the augmented reality environment; and

in response to the second input that corresponds to the request to display the augmented reality environment:

display an animated transition from the simulated field of view of the virtual model to the augmented reality environment; and

display the augmented reality environment

820 Displaying the augmented reality environment in response to the second input comprises displaying the augmented reality environment in accordance with the field of view of the one or more cameras subsequent to detecting the second input

822 The field of view of the one or more cameras subsequent to detecting the second input is different from the field of view of the one or more cameras when the first input was detected

824 The first virtual user interface object moves in the virtual model independently of inputs from a user of the computer system

Figure 8B

826 While displaying the simulated field of view of the virtual model from the perspective of the first virtual user interface object in the virtual model, the first virtual user interface object moves in the virtual model in response to one or more inputs from a user of the computer system

828 While displaying the simulated field of view, detect movement of at least a portion of the computer system, and, in response to detecting the movement of the computer system, change the simulated field of view of the virtual model from the perspective of the first virtual user interface object in accordance with the movement of the computer system.

830 While displaying the simulated field of view of the virtual model from the perspective of the first virtual user interface object in the virtual model, detect a third input that corresponds to selection of a second virtual user interface object in the virtual model; and

in response to detecting the third input that corresponds to selection of the second virtual user interface object:

display a second simulated field of view of the virtual model from a perspective of the second virtual user interface object in the virtual model

832 While displaying the simulated field of view of the virtual model from the perspective of the first virtual user interface object in the virtual model, detect a fourth input that corresponds to a selection of a location in the virtual model other than a virtual user interface object for which an associated simulated field of view can be displayed; and,

in response to detecting the fourth input:

redisplay the augmented reality environment

Figure 8C

900

902 Display, via the display generation component, a first virtual user interface object in a virtual three-dimensional space

904 While displaying the first virtual user interface object in the virtual three-dimensional space, detect, via the input device, a first input that includes selection of a respective portion of the first virtual user interface object and movement of the first input in two dimensions

906 In response to detecting the first input that includes movement of the first input in two dimensions:

in accordance with a determination that the respective portion of the first virtual user interface object is a first portion of the first virtual user interface object, adjust an appearance of the first virtual user interface object in a first direction determined based on the movement of the first input in two dimensions and the first portion of the first virtual user interface object that was selected, wherein the adjustment of the first virtual user interface object in the first direction is constrained to movement in a first set of two dimensions of the virtual three-dimensional space; and,

in accordance with a determination that the respective portion of the first virtual user interface object is a second portion of the first virtual user interface object that is distinct from the first portion of the first virtual user interface object, adjust the appearance of the first virtual user interface object in a second direction that is different from the first direction, wherein the second direction is determined based on the movement of the first input in two dimensions and the second portion of the first virtual user interface object that was selected, wherein the adjustment of the first virtual user interface object in the second direction is constrained to movement in a second set of two dimensions of the virtual three-dimensional space that is different from the first set of two dimensions of the virtual three-dimensional space.

Figure 9A

908 The first portion is a first side of the first virtual user interface object; and the second portion is a second side of the first virtual user interface object, and the first side is not parallel to the second side

910 Adjusting the appearance of the first virtual user interface object includes adjusting the appearance of the first virtual user interface object such that:
a position of the first virtual user interface object is locked to a plane that is parallel to the selected respective portion of the virtual user interface object; and
the two-dimensional movement of the first input corresponds to two dimensional movement of the first virtual user interface object on the plane that is parallel to the selected respective portion of the virtual user interface object

912 Adjusting the appearance of the first virtual user interface object includes displaying a plane-of-movement indicator that includes a visual indication of the plane that is parallel to the selected respective portion of the virtual user interface object

914 The plane-of-movement indicator includes one or more projections that extend from the first virtual user interface object along the plane that is parallel to the selected respective portion of the virtual user interface object

Figure 9B

916 In response to detecting the first input that includes movement of the first input, determine whether the first input meets size adjustment criteria;

in accordance with a determination that the first input meets the size adjustment criteria, adjust the appearance of the first virtual user interface object such that:

a position of the first virtual user interface object is locked to an anchor point in the virtual three-dimensional space; and

a size of the first virtual object is adjusted along an axis that is perpendicular to the selected respective portion of the first virtual user interface object

918 The anchor point is located on a portion of the first virtual user interface object that is opposite to the selected respective portion of the first virtual user interface object

920 The anchor point is a centroid of the first virtual user interface object

922 Adjusting the appearance of the first virtual user interface object includes displaying an axis-of-movement indicator, wherein the axis-of-movement indicator includes a visual indication of an axis that is perpendicular to the selected respective portion of the first virtual user interface object

924 The axis-of-movement indicator includes one or more projections parallel to the axis that is perpendicular to the respective portion of the first virtual user interface object, wherein the one or more projections extend from the first virtual user interface object

926 The computer system includes one or more tactile output generators for generating tactile outputs, and the method includes:

while adjusting an appearance of the first virtual user interface object in a respective direction, determining that the movement of the first input causes a respective portion of the first virtual user interface object to collide with a virtual element that exists in the virtual three-dimensional space; and,

in accordance with the determination that the movement of the first input causes the respective portion of the first virtual user interface object to collide with the virtual element, generating, with the one or more tactile output generators, a tactile output

Figure 9C

928 While displaying the virtual three-dimensional space, detect, via the input device, a second input that is directed to a first location in the virtual three-dimensional space;

in response to detecting the second input, in accordance with a determination that the second input has a first input type, display, at the first location in the virtual three-dimensional space, an insertion cursor;

while the insertion cursor is displayed at the first location, detect, via the input device, a third input; and,

in response to detecting the third input:

in accordance with a determination that the third input has the first input type and is directed to the first location that corresponds to the displayed insertion cursor, insert a second virtual user interface object at the first location; and,

in accordance with a determination that the third input has the first input type and is directed to a second location that does not correspond to the displayed insertion cursor, display the insertion cursor at the second location

930 While displaying the virtual three-dimensional space, detect, via the input device, a fourth input that is directed to a third location in the virtual three-dimensional space;

in response to detecting the fourth input that is directed to the third location in the virtual three-dimensional space, in accordance with a determination that the fourth input has the first input type, display an insertion cursor at the third location;

while the insertion cursor is displayed at the third location, detect, via the input device, a fifth input at a location that corresponds to a new object control that, when activated, causes insertion of a new virtual user interface object at the third location; and,

in response to detecting the fifth input, insert the new virtual user interface object at the third location

932 Detect, via the input device, a gesture that corresponds to an interaction with the virtual three-dimensional space; and,

in response to detecting the gesture that corresponds to the interaction with the virtual three-dimensional space, perform an operation in the virtual three-dimensional space that corresponds to the gesture

Figure 9D

934 The computer system includes one or more cameras, and
the displayed virtual three-dimensional space includes:
one or more physical objects that are in a field of view of the one or more cameras; and
one or more virtual three-dimensional models of the one or more physical objects that are in the field of view of the one or more cameras.

936 The appearance of the first virtual user interface object is adjusted in response to detecting the movement of the first input relative to a respective physical object in the field of view of the one or more cameras without regard to whether the movement of the first input is due to:
movement of the first input on the input device,
movement of the one or more cameras relative to the respective physical object, or
a combination of the movement of the first input on the input device and the movement of the one or more cameras relative to the respective physical object

Figure 9E

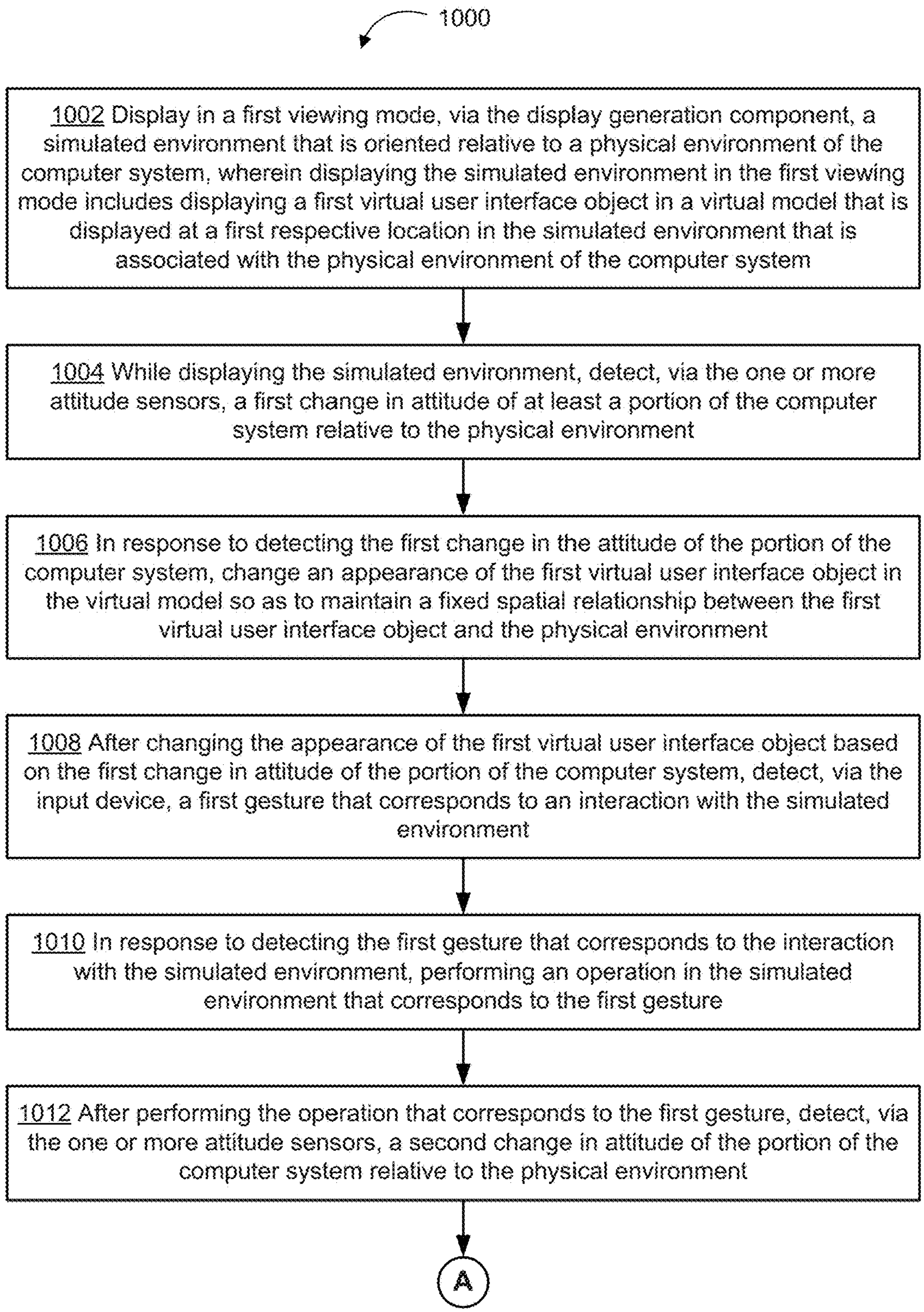
1000
1002 Display in a first viewing mode, via the display generation component, a simulated environment that is oriented relative to a physical environment of the computer system, wherein displaying the simulated environment in the first viewing mode includes displaying a first virtual user interface object in a virtual model that is displayed at a first respective location in the simulated environment that is associated with the physical environment of the computer system
1004 While displaying the simulated environment, detect, via the one or more attitude sensors, a first change in attitude of at least a portion of the computer system relative to the physical environment
1006 In response to detecting the first change in the attitude of the portion of the computer system, change an appearance of the first virtual user interface object in the virtual model so as to maintain a fixed spatial relationship between the first virtual user interface object and the physical environment
1008 After changing the appearance of the first virtual user interface object based on the first change in attitude of the portion of the computer system, detect, via the input device, a first gesture that corresponds to an interaction with the simulated environment
1010 In response to detecting the first gesture that corresponds to the interaction with the simulated environment, performing an operation in the simulated environment that corresponds to the first gesture
1012 After performing the operation that corresponds to the first gesture, detect, via the one or more attitude sensors, a second change in attitude of the portion of the computer system relative to the physical environment
A

Figure 10A

A

1014 In response to detecting the second change in the attitude of the portion of the computer system:

in accordance with a determination that the first gesture met mode change criteria, wherein the mode change criteria include a requirement that the first gesture corresponds to an input that changes a spatial parameter of the simulated environment relative to the physical environment, transition from displaying the simulated environment, including the virtual model, in the first viewing mode to displaying the simulated environment, including the virtual model, in a second viewing mode, wherein displaying the virtual model in the simulated environment in the second viewing mode includes forgoing changing the appearance of the first virtual user interface object to maintain the fixed spatial relationship between the first virtual user interface object and the physical environment; and

in accordance with a determination that the first gesture did not meet the mode change criteria, continue to display the first virtual model in the simulated environment in the first viewing mode, wherein displaying the virtual model in the first viewing mode includes changing an appearance of the first virtual user interface object in the virtual model in response to the second change in attitude of the portion of the computer system relative to the physical environment, so as to maintain the fixed spatial relationship between the first virtual user interface object and the physical environment

1016 The computing system includes one or more cameras; and

displaying the simulated environment in the first viewing mode includes displaying a representation of at least a portion of a field of view of the one or more cameras, wherein the field of view of the one or more cameras includes a representation of a physical object in the physical environment

1018 Detecting the first gesture that corresponds to the interaction with the simulated environment includes:

detecting a plurality of contacts with a touch-sensitive surface of the input device; and,

while the plurality of contacts with the touch-sensitive surface are detected, detecting movement of a first contact of the plurality of contacts relative to movement of a second contact of the plurality of contacts; and

performing the operation in the simulated environment that corresponds to the first gesture includes altering a size of the first virtual user interface object by an amount that corresponds to the movement of the first contact relative to the movement of the second contact

Figure 10B

1020 While displaying the first virtual user interface object in the simulated environment in the second viewing mode:
detect, via the input device, a second gesture that corresponds to an interaction with the simulated environment, wherein the second gesture includes input for altering a perspective of the simulated environment; and,
in response to detecting the second gesture that corresponds to the interaction with the simulated environment, update a displayed perspective of the simulated environment in accordance with the input for altering the perspective of the simulated environment

1022 While displaying the simulated environment in the second viewing mode:
detect, via the input device, an insertion input for inserting a second virtual user interface object at a second respective location in the simulated environment; and,
in response to detecting the insertion input for inserting the second virtual user interface object, display, at the second respective location in the simulated environment, the second virtual user interface object while maintaining the fixed spatial relationship between the first virtual user interface object and the physical environment

1024 While displaying the simulated environment in the second viewing mode:
detect, via the input device, a movement input that includes selection of a respective side of a respective virtual user interface object of the virtual model and movement of the input in two dimensions; and,
in response to detecting the movement, move the respective virtual user interface object within a plane that is parallel to the selected respective side of the respective virtual user interface object in a first direction determined based on the movement of the second input while maintaining the fixed spatial relationship between the first virtual user interface object and the physical environment

Figure 10C

1026 While transitioning from displaying the simulated environment in the first viewing mode to displaying the simulated environment in the second viewing mode, display a transition animation to provide a visual indication of the transition

1028 Displaying the transition animation includes gradually ceasing to display at least one visual element that is displayed in the first viewing mode and is not displayed in the second viewing mode

1030 Displaying the transition animation includes gradually displaying at least one visual element of the second viewing mode that is not displayed in the first viewing mode

1032 In response to detecting the first gesture that corresponds to the interaction with the simulated environment, alter a perspective with which the virtual model in the simulated environment is displayed in accordance with the change to the spatial parameter by the input that corresponds to the first gesture

1034 After detecting an end of the first gesture, continue to alter a perspective with which the virtual model in the simulated environment is displayed to indicate the transitioning from displaying the simulated environment in the first viewing mode to displaying the simulated environment in the second viewing mode

Figure 10D

1036 While displaying the simulated environment in the second viewing mode, detect, via the input device, a third gesture that corresponds to an input for transitioning from the second viewing mode to the first viewing mode; and

in response to detecting the third gesture, transition from displaying the simulated environment in the second viewing mode to displaying the simulated environment in the first viewing mode

1038 The input device includes a touch-sensitive surface;

detecting the third gesture that corresponds to the input for transitioning from the second viewing mode to the first viewing mode includes:

detecting the plurality of contacts with the touch-sensitive surface of the input device; and,

while the plurality of contacts with the touch-sensitive surface are detected, detecting movement of the first contact of the plurality of contacts relative to movement of the second contact of the plurality of contacts; and

transitioning from displaying the simulated environment in the second viewing mode to displaying the simulated environment in the first viewing mode includes altering a size of the virtual model in the simulated environment to return to a size of the virtual model prior to the transition from the first viewing mode to the second viewing mode

1040 The third gesture includes an input at a position on the input device that corresponds to a control that, when activated, causes the transition from the second viewing mode to the first viewing mode

1042 In response to detecting the third gesture, transition the position of the first virtual user interface object from a current position relative to the physical environment to a prior position relative to the physical environment so as to return to the fixed spatial relationship between the first virtual user interface object and the physical environment

1044 After detecting an end of the third gesture, continue to alter a perspective with which the virtual model in the simulated environment is displayed to indicate the transitioning from displaying the simulated environment in the second viewing mode to displaying the simulated environment in the first viewing mode

Figure 10E

1100

1102 Display, via the first display generation component of the first computer system, a simulated environment that is oriented relative to a first physical environment of the first computer system

1104 Displaying the simulated environment includes concurrently displaying:
a first virtual user interface object in a virtual model that is displayed at a respective location in the simulated environment that is associated with the first physical environment of the first computer system; and
a visual indication of a viewing perspective of a second computer system of the simulated environment, wherein the second computer system is a computer system having a second display generation component, one or more second attitude sensors, and a second input device that is displaying, via the second display generation component of the second computer system, a view of the simulated environment that is oriented relative to a second physical environment of the second computer system

1106 While displaying the simulated environment via the first display generation component of the first computer system, detect a change in the viewing perspective of the second computer system of the simulated environment based on a change in the attitude of a portion of the second computer system relative to the second physical environment of the second computer system

1108 In response to detecting the change in the viewing perspective of the second computer system of the simulated environment based on the change in the attitude of the portion of the second computer system relative to the physical environment of the second computer system, update the visual indication of the viewing perspective of the second computer system of the simulated environment displayed via the first display generation component of the first computer system in accordance with the change in the viewing perspective of the second computer system of the simulated environment

1110 The visual indication of the viewing perspective of the second computer system includes a representation of the second computer system that is displayed at a position in the simulated environment that corresponds to the second computer system

1112 The representation of the second computer system includes an identification indicator that corresponds to the second computer system

Figure 11A

1114 The visual indication of the viewing perspective of the second computer system includes an indicator that emanates from a position in the simulated environment that corresponds to the second computer system to indicate a line of sight of the second computer system

1116 Displaying the simulated environment includes:
in accordance with a determination that the second computer system in the simulated environment is interacting with the first virtual user interface object, displaying, via the first display generation component of the first computer system, an interaction indicator that is visually associated with the first virtual user interface object

1118 Displaying the simulated environment includes:
in accordance with a determination that the interaction of the second computer system with the first virtual user interface object includes an object manipulation input, changing an appearance of the first virtual user interface object in accordance with the object manipulation input

1120 Changing the appearance of the first virtual user interface object in accordance with the object manipulation input includes displaying movement of the interaction indicator that is visually associated with the first virtual user interface object, and
the movement of the interaction indicator corresponds to the object manipulation input

1122 The interaction indicator includes a visual indication of a connection between a position that corresponds to the second computer system in the simulated environment and the first virtual user interface object

1124 The interaction indicator includes a visual indication of a point of interaction with the first user interface object

A

Figure 11B

1116 Displaying the simulated environment includes:
in accordance with a determination that the second computer system in the simulated environment is interacting with the first virtual user interface object, displaying, via the first display generation component of the first computer system, an interaction indicator that is visually associated with the first virtual user interface object

A

1126 Displaying the simulated environment includes:
detecting, via the first computer system, a first physical reference object in the first physical environment; and
displaying, in the simulated environment displayed via the first display generation component of the first computer system, the first virtual user interface object at a position relative to the first physical reference object; and,
the method includes, in response to detecting the change in the viewing perspective of the second computer system, updating the position of the interaction indicator relative to the first physical reference object

1128 The second physical environment of the second computer system is distinct from the first physical environment of the first computer system;
the second computer system detects a second physical reference object in the second physical environment; and
in the simulated environment displayed via the second display generation component of the second computer system, the first virtual user interface object is displayed at a location relative to the second physical reference object that corresponds to the location of the first virtual user interface object relative to the first physical reference object

1130 The first physical environment of the first computer system includes at least a portion of the second physical environment of the second computer system; and
the second computer system is visible in the simulated environment displayed via the first display generation component

1132 Detect, by the first input device, a remote device perspective input; and
in response to detecting the remote device perspective input, replace display of the simulated environment that is oriented relative to the first physical environment of the first computer system with display of the simulated environment that is oriented relative to the second physical environment of the second computer system

Figure 11C

1200

1202 Display, via a display generation component, a simulated environment

1204 While displaying the simulated environment, detect, via an input device, a first input that is directed to a respective location in the simulated environment

1206 In response to detecting the first input that is directed to the respective location in the simulated environment:

in accordance with a determination that the first input was of a first input type and that the first input was detected at a first location in the simulated environment other than a current location of an insertion cursor in the simulated environment, display the insertion cursor at the first location; and,

in accordance with a determination that the first input was of the first input type and that the first input was detected at a second location in the simulated environment that corresponds to the current location of the insertion cursor, insert a first object at the second location and moving the insertion cursor to a third location that is on the first object

1208 Repeatedly perform the method over a plurality of successive iterations, wherein:

in a first iteration of the successive iterations, the first input is of the first type and is detected at the first location in the simulated environment, and in response the insertion cursor is displayed at the first location; and,

in a second iteration of the successive iterations, the first input is of the first type and is detected at the second location in the simulated environment that corresponds to the current location of the insertion points, and in response the first object is inserted at the second location and the insertion cursor is moved to the third location that is on the first object

1210 The first object has a plurality of non-adjacent sides, which are not adjacent to the second location that corresponds to the current location of the insertion cursor, and the third location on the first object is on a respective non-adjacent side of the plurality of non-adjacent sides that are not adjacent to the second location

Figure 12A

1212 In accordance with a determination that the current location of an insertion cursor is located on a respective side of a preexisting object, the third location is on a first respective side of the first object that is parallel to the respective side of the preexisting object

1214 The first location is on a first side of the preexisting object and the second location is on a second side of the preexisting object that is different from the first side of the preexisting object

1216 The simulated environment is oriented relative to a physical environment of the computer system and inserting the first object at the second location includes inserting the first object in the simulated environment at a location in the simulated environment that is associated with a respective location of a respective physical reference object in the physical environment of the computer system

1218 In response to detecting the first input that is directed to the respective location in the simulated environment, in accordance with a determination that the first input was of a second input type and the insertion cursor is displayed at the second location in the simulated environment, insert the first object at the second location in the simulated environment and move the insertion cursor to the third location on the first object

1220 Detect a second input that includes selection of a second respective side of the first object and movement of the second input in two dimensions

1222 In response to detecting the second input that includes movement of the second input in two dimensions:

in accordance with a determination that the second input meets movement criteria, move the first object within a first plane that is parallel to the selected second respective side of the first object in a first direction determined based on the movement of the second input; and,

in accordance with a determination that the second input does not meet movement criteria, forgo moving the first object

Figure 12B

1224 Detect a third input that includes selection of a third respective side of the first object and movement of the third input in two dimensions

1226 In response to detecting the third input that includes movement of the third input in two dimensions:

in accordance with a determination that the third input meets resize criteria, adjust, based on the movement of the third input, a size of the first object along an axis that is perpendicular to the selected third respective side of the first object; and,

in accordance with a determination that the third input does not meet resize criteria, forgo adjusting the size of the first object

1228 Detect a fourth input that includes selection of a fourth respective side of the first object and movement of the fourth input in two dimensions

1230 In response to detecting the fourth input that includes movement of the second input in two dimensions:

in accordance with a determination that the contact meets resizing criteria, adjust a size of the first object based on the movement of the fourth input; and,

in accordance with a determination that the contact does not meet resizing criteria, move the first object based on the movement of the fourth input.

1232 Adjusting the size of the first object based on the movement of the fourth input includes adjusting the size of the first object along an axis that is perpendicular to the selected third respective side of the first object.

1234 Moving the first object based on the movement of the fourth input includes moving the first object within a first plane that is parallel to the selected second respective side of the first object in a first direction determined based on the movement of the second input.

Figure 12C

1236 While the first object is displayed, detect a fifth input on a respective portion of the first object that does not correspond to the third location that is on the first object

↓

1238 In response to detecting the fifth input, moving the insertion cursor from the third location to a location that corresponds to the respective portion of the first object

Figure 12D

1300

1302 Display, via a display generation component, an augmented reality environment, wherein displaying the augmented reality environment includes concurrently displaying:

a representation of at least a portion of a field of view of one or more cameras that includes a physical object and that is updated as contents of the field of view of the one or more cameras change, and

a virtual user interface object at a respective location in the representation of the field of view of the one or more cameras, wherein the respective location of the virtual user interface object in the representation of the field of view of the one or more cameras is determined based on a fixed spatial relationship between the virtual user interface object and the physical object included in the representation of the field of view of the one or more cameras

↓

1304 While displaying the augmented reality environment, detect, via one or more attitude sensors, a first change in attitude of at least a portion of the computer system relative to a physical environment of the computer system

↓

A

Figure 13A

A

1306 In response to detecting the first change in attitude of the portion of the computer system relative to the physical environment of the computer system, update the augmented reality environment in accordance with the first change in attitude of the portion of the computer system, where:

in accordance with a determination that the augmented reality environment is displayed in a non-stabilized mode of operation, updating the augmented reality environment in accordance with the first change in attitude of the portion of the computer system includes:

updating the representation of the portion of the field of view of the one or more cameras by a first amount of adjustment that is based on the first change in attitude of the portion of the computer system relative to the physical environment of the computer system; and

updating the respective location of the virtual user interface object to a location that is selected so as to maintain the fixed spatial between the virtual user interface object and the physical object included in the representation of the field of view of the one or more cameras; and,

in accordance with a determination that the augmented reality environment is displayed in a stabilized mode of operation, updating the augmented reality environment in accordance with the first change in attitude of the portion of the computer system includes:

updating the representation of the portion of the field of view of the one or more cameras by a second amount of adjustment that is based on the first change in attitude of the portion of the computer system relative to the physical environment of the computer system and that is less than the first amount of adjustment; and

updating the respective location of the virtual user interface object to a location that is selected so as to maintain the fixed spatial relationship between the virtual user interface object and the physical object included in the representation of the field of view of the one or more cameras.

Figure 13B

1308 When the augmented reality environment was displayed in the non-stabilized mode of operation when the first change in attitude of the portion of the computer system was detected, after updating the augmented reality environment in accordance with the first change in attitude of the portion of the computer system

1308-a

receive a request to stabilize the virtual user interface object on the display;

1308-b

in response to the request to stabilize the virtual user interface object on the display, enter a stabilized mode of operation for the augmented reality environment; and

1308-c

while in the stabilized mode of operation for the augmented reality environment:

detect, via the one or more orientation sensors, a second change in attitude of the portion of the computer system relative to the physical environment;

in response to detecting the second change in attitude of the portion of the computer system relative to the physical environment, update the augmented reality environment in accordance with the second change in attitude of the portion of the computer system, including:

updating the representation of the portion of the field of view of the one or more cameras by less than an amount of the second change in attitude of the portion of the computer system relative to the physical environment; and

updating the virtual user interface object to a location selected so as to maintain the fixed spatial relationship between the virtual user interface object and the representation of the physical object included in the field of view of the one or more cameras

1310 The computer system includes an input device and the request to stabilize the virtual user interface object on the display includes an input, received via the input device, for zooming at least a portion of the augmented reality environment

1312 In response to the request to stabilize the virtual user interface object on the display, wherein the request to stabilize the virtual user interface object on the display includes the input for zooming the portion of the displayed augmented reality environment, re-render the virtual user interface object in accordance with the magnitude of the input for zooming the portion of the displayed augmented reality environment

Figure 13C

1314 The physical object is replaced by the virtual user interface object in the displayed augmented reality environment

1316 Detect a first respective change in attitude of the portion of the computer system relative to the physical environment of the computer system while the augmented reality environment is displayed in the stabilized mode of operation

1318 In response to detecting the first respective change in attitude of the portion of the computer system relative to the physical environment of the computer system while the augmented reality environment is displayed in the stabilized mode of operation, update the augmented reality environment in accordance with the respective change in attitude of the portion of the computer system, including, in accordance with a determination that the updated respective location of the virtual user interface object extends beyond the field of view of the one or more cameras, updating the representation of the portion of the field of view of the one or more cameras includes displaying a placeholder image at a respective location in the augmented reality environment that corresponds to the portion of the virtual user interface object that extends beyond the field of view of the one or more cameras

1320 Detect a second respective change in attitude of the portion of the computer system relative to the physical environment of the computer system while the augmented reality environment is displayed in the stabilized mode of operation

1322 In response to detecting the second respective change in attitude of the portion of the computer system relative to the physical environment of the computer system while the augmented reality environment is displayed in the stabilized mode of operation, update the augmented reality environment in accordance with the respective change in attitude of the portion of the computer system, including, in accordance with a determination that the updated respective location of the virtual user interface object extends beyond the field of view of the one or more cameras, ceasing to display at least a portion of the virtual user interface object

Figure 13D

1324 In response to detecting the respective change in attitude of the portion of the computer system relative to the physical environment of the computer system while the augmented reality environment is displayed in the stabilized mode of operation, updating the augmented reality environment in accordance with the respective change in attitude of the portion of the computer system includes:

in accordance with a determination that the updated respective location of the virtual user interface object extends beyond the field of view of the one or more cameras, zooming the displayed augmented reality environment to increase a portion of the displayed virtual user interface object; and,

in accordance with a determination that the updated respective location of the virtual user interface object does not extend beyond the field of view of the one or more cameras, moving the virtual user interface object without zooming the displayed augmented reality environment

Figure 13E

SYSTEMS, METHODS, AND GRAPHICAL USER INTERFACES FOR INTERACTING WITH AUGMENTED AND VIRTUAL REALITY ENVIRONMENTS

RELATED APPLICATIONS

[0001] This application claims priority to U.S. Provisional Patent Application No. 62/553,063, filed Aug. 31, 2017, and Provisional Patent Application No. 62/564,984, filed Sep. 28, 2017, both of which are hereby incorporated by reference in their entireties.

TECHNICAL FIELD

[0002] This relates generally to computer systems for virtual/augmented reality, including but not limited to electronic devices for interacting with augmented and virtual reality environments.

BACKGROUND

[0003] The development of computer systems for virtual/augmented reality has increased significantly in recent years. Example virtual/augmented reality environments include at least some virtual elements that replace or augment the physical world. Input devices, such as touch-sensitive surfaces, for computer systems and other electronic computing devices are used to interact with virtual/augmented reality environments. Example touch-sensitive surfaces include touchpads, touch-sensitive remote controls, and touch-screen displays. Such surfaces are used to manipulate user interfaces and objects therein on a display. Example user interface objects include digital images, video, text, icons, and control elements such as buttons and other graphics.

[0004] But methods and interfaces for interacting with environments that include at least some virtual elements (e.g., augmented reality environments, mixed reality environments, and virtual reality environments) are cumbersome, inefficient, and limited. For example, using a sequence of inputs to select one or more user interface objects (e.g., one or more virtual elements in the virtual/augmented reality environment) and perform one or more actions on the selected user interface objects is tedious, creates a significant cognitive burden on a user, and detracts from the experience with the virtual/augmented reality environment. In addition, these methods take longer than necessary, thereby wasting energy. This latter consideration is particularly important in battery-operated devices.

SUMMARY

[0005] Accordingly, there is a need for computer systems with improved methods and interfaces for interacting with augmented and virtual reality environments. Such methods and interfaces optionally complement or replace conventional methods for interacting with augmented and virtual reality environments. Such methods and interfaces reduce the number, extent, and/or nature of the inputs from a user and produce a more efficient human-machine interface. For battery-operated devices, such methods and interfaces conserve power and increase the time between battery charges.

[0006] The above deficiencies and other problems associated with user interfaces for virtual/augmented reality are reduced or eliminated by the disclosed computer systems. In some embodiments, the computer system includes a desktop computer. In some embodiments, the computer system is portable (e.g., a notebook computer, tablet computer, or handheld device). In some embodiments, the computer system includes a personal electronic device (e.g., a wearable electronic device, such as a watch). In some embodiments, the computer system has (and/or is in communication with) a touchpad. In some embodiments, the computer system has (and/or is in communication with) a touch-sensitive display (also known as a "touch screen" or "touch-screen display"). In some embodiments, the computer system has a graphical user interface (GUI), one or more processors, memory and one or more modules, programs or sets of instructions stored in the memory for performing multiple functions. In some embodiments, the user interacts with the GUI in part through stylus and/or finger contacts and gestures on the touch-sensitive surface. In some embodiments, the functions optionally include game playing, image editing, drawing, presenting, word processing, spreadsheet making, telephoning, video conferencing, e-mailing, instant messaging, workout support, digital photographing, digital videoing, web browsing, digital music playing, note taking, and/or digital video playing. Executable instructions for performing these functions are, optionally, included in a non-transitory computer readable storage medium or other computer program product configured for execution by one or more processors.

[0007] In accordance with some embodiments, a method is performed at a computer system having a display generation component, one or more cameras, and an input device. The method includes displaying, via the display generation component, an augmented reality environment. Displaying the augmented reality environment includes concurrently displaying: a representation of at least a portion of a field of view of the one or more cameras that includes a respective physical object, wherein the representation is updated as contents of the field of view of the one or more cameras change; and a respective virtual user interface object at a respective location in the representation of the field of view of the one or more cameras, wherein the respective virtual user interface object has a location that is determined based on the respective physical object in the field of view of the one or more cameras. The method also includes, while displaying the augmented reality environment, detecting an input at a location that corresponds to the respective virtual user interface object. The method further includes, while continuing to detect the input: detecting movement of the input relative to the respective physical object in the field of view of the one or more cameras; and, in response to detecting the movement of the input relative to the respective physical object in the field of view of the one or more cameras, adjusting an appearance of the respective virtual user interface object in accordance with a magnitude of movement of the input relative to the respective physical object.

[0008] In accordance with some embodiments, a method is performed at a computer system having a display generation component, one or more cameras, and an input device. The method includes displaying, via the display generation component, an augmented reality environment. Displaying the augmented reality environment includes concurrently displaying: a representation of at least a portion of a field of view of the one or more cameras that includes a respective physical object, wherein the representation is updated as contents of the field of view of the one or more cameras change; and a respective virtual user interface object at a respective location in the representation of the field of view of the one or more cameras, wherein the respective virtual user interface object has a location that is determined based on the respective physical object in the field of view of the one or more cameras. The method also includes, while displaying the augmented reality environment, detecting an input that changes a virtual environment setting for the augmented reality environment. The method further includes, in response to detecting the input that changes the virtual environment setting: adjusting an appearance of the respective virtual user interface object in accordance with the change made to the virtual environment setting for the augmented reality environment; and applying a filter to at least a portion of the representation of the field of view of the one or more cameras, wherein the filter is selected based on the change made to the virtual environment setting.

[0009] In accordance with some embodiments, a method is performed at a computer system having a display generation component, one or more cameras, and an input device. The method includes displaying, via the display generation component, an augmented reality environment. Displaying the augmented reality environment includes concurrently displaying: a representation of at least a portion of a field of view of the one or more cameras that includes a respective physical object, wherein the representation is updated as contents of the field of view of the one or more cameras change; and a first virtual user interface object in a virtual model that is displayed at a respective location in the representation of the field of view of the one or more cameras, wherein the first virtual user interface object has a location that is determined based on the respective physical object in the field of view of the one or more cameras. The method also includes, while displaying the augmented reality environment, detecting a first input that corresponds to selection of the first virtual user interface object; and, in response to detecting the first input that corresponds to selection of the first virtual user interface object, displaying a simulated field of view of the virtual model from a perspective of the first virtual user interface object in the virtual model.

[0010] In accordance with some embodiments, a method is performed at a computer system with a display generation component and an input device. The method includes displaying, via the display generation component, a first virtual user interface object in a virtual three-dimensional space. The method also includes, while displaying the first virtual user interface object in the virtual three-dimensional space, detecting, via the input device, a first input that includes selection of a respective portion of the first virtual user interface object and movement of the first input in two dimensions. The method further includes, in response to detecting the first input that includes movement of the first input in two dimensions: in accordance with a determination that the respective portion of the first virtual user interface object is a first portion of the first virtual user interface object, adjusting an appearance of the first virtual user interface object in a first direction determined based on the movement of the first input in two dimensions and the first portion of the first virtual user interface object that was selected, wherein the adjustment of the first virtual user interface object in the first direction is constrained to movement in a first set of two dimensions of the virtual three-dimensional space; and, in accordance with a determination that the respective portion of the first virtual user interface object is a second portion of the first virtual user interface object that is distinct from the first portion of the first virtual user interface object, adjusting the appearance of the first virtual user interface object in a second direction that is different from the first direction, wherein the second direction is determined based on the movement of the first input in two dimensions and the second portion of the first virtual user interface object that was selected, wherein the adjustment of the first virtual user interface object in the second direction is constrained to movement in a second set of two dimensions of the virtual three-dimensional space that is different from the first set of two dimensions of the virtual three-dimensional space.

[0011] In accordance with some embodiments, a method is performed at a computer system with a display generation component, one or more attitude sensors, and an input device. The method includes displaying in a first viewing mode, via the display generation component, a simulated environment that is oriented relative to a physical environment of the computer system, wherein displaying the simulated environment in the first viewing mode includes displaying a first virtual user interface object in a virtual model that is displayed at a first respective location in the simulated environment that is associated with the physical environment of the computer system. The method also includes, while displaying the simulated environment, detecting, via the one or more attitude sensors, a first change in attitude of at least a portion of the computer system relative to the physical environment; and in response to detecting the first change in the attitude of the portion of the computer system, changing an appearance of the first virtual user interface object in the virtual model so as to maintain a fixed spatial relationship between the first virtual user interface object and the physical environment. The method further includes, after changing the appearance of the first virtual user interface object based on the first change in attitude of the portion of the computer system, detecting, via the input device, a first gesture that corresponds to an interaction with the simulated environment; and in response to detecting the first gesture that corresponds to the interaction with the simulated environment, performing an operation in the simulated environment that corresponds to the first gesture. In addition, the method includes, after performing the operation that corresponds to the first gesture, detecting, via the one or more attitude sensors, a second change in attitude of the portion of the computer system relative to the physical environment; and in response to detecting the second change in the attitude of the portion of the computer system: in accordance with a determination that the first gesture met mode change criteria, wherein the mode change criteria include a requirement that the first gesture corresponds to an input that changes a spatial parameter of the simulated environment relative to the physical environment, transitioning from displaying the simulated environment, including the virtual model, in the first viewing mode to displaying the simulated environment, including the virtual model, in a second viewing mode, wherein displaying the virtual model in the simulated environment in the second viewing mode includes forgoing changing the appearance of the first virtual user interface object to maintain the fixed spatial relationship between the first virtual user interface object and the physical environment; and in accordance with a determination that the first gesture did not meet the mode change criteria, continuing to display the first virtual model in the simulated environment in the first viewing mode, wherein displaying the virtual model in the first viewing mode includes changing an appearance of the first virtual user interface object in the virtual model in response to the second change in attitude of the portion of the computer system relative to the physical environment, so as to maintain the fixed spatial relationship between the first virtual user interface object and the physical environment.

[0012] In accordance with some embodiments, a method is performed at a first computer system with a first display generation component, one or more first attitude sensors, and a first input device. The method includes displaying, via the first display generation component of the first computer system, a simulated environment that is oriented relative to a first physical environment of the first computer system, wherein displaying the simulated environment includes concurrently displaying: a first virtual user interface object in a virtual model that is displayed at a respective location in the simulated environment that is associated with the first physical environment of the first computer system; and a visual indication of a viewing perspective of a second computer system of the simulated environment, wherein the second computer system is a computer system having a second display generation component, one or more second attitude sensors, and a second input device, that is displaying, via the second display generation component of the second computer system, a view of the simulated environment that is oriented relative to a second physical environment of the second computer system. The method also includes, while displaying the simulated environment via the first display generation component of the first computer system, detecting a change in the viewing perspective of the second computer system of the simulated environment based on a change in the attitude of a portion of the second computer system relative to the second physical environment of the second computer system. The method further includes, in response to detecting the change in the viewing perspective of the second computer system of the simulated environment based on the change in the attitude of the portion of the second computer system relative to the physical environment of the second computer system, updating the visual indication of the viewing perspective of the second computer system of the simulated environment displayed via the first display generation component of the first computer system in accordance with the change in the viewing perspective of the second computer system of the simulated environment.

[0013] In accordance with some embodiments, a method is performed at a computer system with a display generation component, one or more attitude sensors, and an input device. The method includes displaying, via the display generation component, a simulated environment. The method also includes, while displaying the simulated environment, detecting, via the input device, a first input that is directed to a respective location in the simulated environment. The method also includes, in response to detecting the first input that is directed to the respective location in the simulated environment: in accordance with a determination that the first input was of a first input type and that the first input was detected at a first location in the simulated environment other than a current location of an insertion cursor in the simulated environment, displaying the insertion cursor at the first location; and, in accordance with a determination that the first input was of the first input type and that the first input was detected at a second location in the simulated environment that corresponds to the current location of the insertion cursor, inserting a first object at the second location and moving the insertion cursor to a third location that is on the first object.

[0014] In accordance with some embodiments, a method is performed at a computer system with a display generation component, one or more cameras, and one or more attitude sensors. The method includes displaying, via the display generation component, an augmented reality environment, wherein displaying the augmented reality environment includes concurrently displaying: a representation of at least a portion of a field of view of the one or more cameras that includes a physical object and that is updated as contents of the field of view of the one or more cameras change; and a virtual user interface object at a respective location in the representation of the field of view of the one or more cameras, wherein the respective location of the virtual user interface object in the representation of the field of view of the one or more cameras is determined based on a fixed spatial relationship between the virtual user interface object and the physical object included in the representation of the field of view of the one or more cameras. The method also includes, while displaying the augmented reality environment, detecting, via the one or more attitude sensors, a first change in attitude of at least a portion of the computer system relative to a physical environment of the computer system. The method also includes, in response to detecting the first change in attitude of the portion of the computer system relative to the physical environment of the computer system, updating the augmented reality environment in accordance with the first change in attitude of the portion of the computer system, where: in accordance with a determination that the augmented reality environment is displayed in a non-stabilized mode of operation, updating the augmented reality environment in accordance with the first change in attitude of the portion of the computer system includes: updating the representation of the portion of the field of view of the one or more cameras by a first amount of adjustment that is based on the first change in attitude of the portion of the computer system relative to the physical environment of the computer system; and updating the respective location of the virtual user interface object to a location that is selected so as to maintain the fixed spatial between the virtual user interface object and the physical object included in the representation of the field of view of the one or more cameras; and, in accordance with a determination that the augmented reality environment is displayed in a stabilized mode of operation, updating the augmented reality environment in accordance with the first change in attitude of the portion of the computer system includes: updating the representation of the portion of the field of view of the one or more cameras by a second amount of adjustment that is based on the first change in attitude of the portion of the computer system relative to the physical environment of the computer system and that is less than the first amount of adjustment; and updating the respective location of the virtual user interface object to a location that is selected so as to maintain the fixed spatial relationship between the virtual user interface object and the physical object included in the representation of the field of view of the one or more cameras.

[0015] In accordance with some embodiments, a computer system includes (and/or is in communication with) a display generation component (e.g., a display, a projector, a heads-up display, or the like), one or more cameras (e.g., video cameras that continuously provide a live preview of at least a portion of the contents that are within the field of view of the cameras and optionally generate video outputs including one or more streams of image frames capturing the contents within the field of view of the cameras), and one or more input devices (e.g., a touch-sensitive surface, such as a touch-sensitive remote control, or a touch-screen display that also serves as the display generation component, a mouse, a joystick, a wand controller, and/or cameras tracking the position of one or more features of the user such as the user's hands), optionally one or more attitude sensors, optionally one or more sensors to detect intensities of contacts with the touch-sensitive surface, optionally one or more tactile output generators, one or more processors, and memory storing one or more programs; the one or more programs are configured to be executed by the one or more processors and the one or more programs include instructions for performing or causing performance of the operations of any of the methods described herein. In accordance with some embodiments, a computer readable storage medium has stored therein instructions which, when executed by a computer system that includes (and/or is in communication with) a display generation component, one or more cameras, one or more input devices, optionally one or more attitude sensors, optionally one or more sensors to detect intensities of contacts with the touch-sensitive surface, and optionally one or more tactile output generators, cause the computer system to perform or cause performance of the operations of any of the methods described herein. In accordance with some embodiments, a graphical user interface on a computer system that includes (and/or is in communication with) a display generation component, one or more cameras, one or more input devices, optionally one or more attitude sensors, optionally one or more sensors to detect intensities of contacts with the touch-sensitive surface, optionally one or more tactile output generators, a memory, and one or more processors to execute one or more programs stored in the memory includes one or more of the elements displayed in any of the methods described herein, which are updated in response to inputs, as described in any of the methods described herein. In accordance with some embodiments, a computer system includes (and/or is in communication with) a display generation component, one or more cameras, one or more input devices, optionally one or more attitude sensors, optionally one or more sensors to detect intensities of contacts with the touch-sensitive surface, optionally one or more tactile output generators, and means for performing or causing performance of the operations of any of the methods described herein. In accordance with some embodiments, an information processing apparatus, for use in a computer system that includes (and/or is in communication with) a display generation component, one or more cameras, one or more input devices, optionally one or more attitude sensors, optionally one or more sensors to detect intensities of contacts with the touch-sensitive surface, and optionally one or more tactile output generators, includes means for performing or causing performance of the operations of any of the methods described herein.

[0016] Thus, computer systems that have (and/or are in communication with) a display generation component, one or more cameras, one or more input devices, optionally one or more attitude sensors, optionally one or more sensors to detect intensities of contacts with the touch-sensitive surface, and optionally one or more tactile output generators, are provided with improved methods and interfaces for interacting with augmented and virtual reality environments, thereby increasing the effectiveness, efficiency, and user satisfaction with such computer systems. Such methods and interfaces may complement or replace conventional methods for interacting with augmented and virtual reality environments.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] For a better understanding of the various described embodiments, reference should be made to the Description of Embodiments below, in conjunction with the following drawings in which like reference numerals refer to corresponding parts throughout the figures.

[0018] FIG. **1**A is a block diagram illustrating a portable multifunction device with a touch-sensitive display in accordance with some embodiments.

[0019] FIG. **1**B is a block diagram illustrating example components for event handling in accordance with some embodiments.

[0020] FIG. **2** illustrates a portable multifunction device having a touch screen in accordance with some embodiments.

[0021] FIG. **3**A is a block diagram of an example multifunction device with a display and a touch-sensitive surface in accordance with some embodiments.

[0022] FIGS. **3**B-**3**C are block diagrams of example computer systems in accordance with some embodiments.

[0023] FIG. **4**A illustrates an example user interface for a menu of applications on a portable multifunction device in accordance with some embodiments.

[0024] FIG. **4**B illustrates an example user interface for a multifunction device with a touch-sensitive surface that is separate from the display in accordance with some embodiments.

[0025] FIGS. **4**C-**4**E illustrate examples of dynamic intensity thresholds in accordance with some embodiments.

[0026] FIGS. **5**A**1**-**5**A**40** illustrate example user interfaces for displaying an augmented reality environment and, in response to different inputs, adjusting the appearance of the augmented reality environment and/or the appearance of objects in the augmented reality environment, as well as transitioning between viewing a virtual model in the augmented reality environment and viewing simulated views of the virtual model from the perspectives of objects in the virtual model, in accordance with some embodiments.

[0027] FIGS. **5**B **1**-**5**B**41** illustrate examples of systems and user interfaces for three-dimensional manipulation of virtual user interface objects, in accordance with some embodiments.

[0028] FIGS. **5**C**1**-**5**C**30** illustrate examples of systems and user interfaces for transitioning between viewing modes of a displayed simulated environment, in accordance with some embodiments.

[0029] FIGS. **5**D**1**-**5**D**14**C illustrate examples of systems and user interfaces for multiple users to interact with virtual user interface objects in a displayed simulated environment, in accordance with some embodiments.

[0030] FIGS. **5**E**1**-**5**E**32** illustrate examples of systems and user interfaces for placement of an insertion cursor, in accordance with some embodiments.

[0031] FIGS. 5F1-5F17*b* illustrate examples of systems and user interfaces for displaying an augmented reality environment in a stabilized mode of operation, in accordance with some embodiments.

[0032] FIGS. 6A-6D are flow diagrams of a process for adjusting an appearance of a virtual user interface object in an augmented reality environment, in accordance with some embodiments.

[0033] FIGS. 7A-7C are flow diagrams of a process for applying a filter on a live image captured by one or more cameras of a computer system in an augmented reality environment, in accordance with some embodiments.

[0034] FIGS. 8A-8C are flow diagrams of a process for transitioning between viewing a virtual model in the augmented reality environment and viewing simulated views of the virtual model from the perspectives of objects in the virtual model, in accordance with some embodiments.

[0035] FIGS. 9A-9E are flow diagrams of a process for three-dimensional manipulation of virtual user interface objects, in accordance with some embodiments.

[0036] FIGS. 10A-10E are flow diagrams of a process for transitioning between viewing modes of a displayed simulated environment, in accordance with some embodiments.

[0037] FIGS. 11A-11C are flow diagrams of a process for updating an indication of a viewing perspective of a second computer system in a simulated environment displayed by a first computer system, in accordance with some embodiments.

[0038] FIGS. 12A-12D are flow diagrams of a process for placement of an insertion cursor, in accordance with some embodiments.

[0039] FIGS. 13A-13E are flow diagrams of a process for displaying an augmented reality environment in a stabilized mode of operation, in accordance with some embodiments.

DESCRIPTION OF EMBODIMENTS

[0040] An augmented reality environment is an environment in which reality is augmented with supplemental information that provides additional information to a user that is not available in the physical world. Conventional methods of interacting with augmented reality environments (e.g., to access the supplemental information) often require multiple separate inputs (e.g., a sequence of gestures and button presses, etc.) to achieve an intended outcome. Further, conventional methods of inputs are often limited in range (e.g., by the size of the touch-sensitive display of a computer system). The embodiments herein provide an intuitive way for a user to interact with an augmented reality environment (e.g., by adjusting an appearance of a virtual user interface object based on a combination of movement of the computer system and movement of a contact on an input device (e.g., a touch-screen display) of the computer system, and by applying a filter in real-time on a live image captured by one or more cameras of the computer system, where the filter is selected based on a virtual environment setting for the augmented reality environment).

[0041] Additionally, conventional interactions with virtual/augmented reality environments are generally limited to a single perspective (e.g., from the perspective of the user wearing/holding the device). The embodiments herein provide a more immersive and intuitive way to experience the virtual/augmented reality environment by presenting simulated views of a virtual model (e.g., of a physical object) in a virtual reality environment from the perspectives of virtual user interface objects (e.g., from the perspectives of a car or a person in the augmented reality environment).

[0042] The systems, methods, and GUIs described herein improve user interface interactions with virtual/augmented reality environments in multiple ways. For example, they make it easier to: display an augmented reality environment and, in response to different inputs, adjust the appearance of the augmented reality environment and/or of objects therein; transition between viewing a virtual model in the augmented reality environment and viewing simulated views of the virtual model from the perspectives of objects in the virtual model; and three-dimensional manipulation of virtual user interface objects.

[0043] Below, FIGS. 1A-1B, 2, and 3A-3C provide a description of example devices. FIGS. 4A-4B, 5A1-5A40, 5B1-5B41, 5C1-5C30, 5D1-5D14, 5E1-5E32, and 5F1-5F 17 illustrate examples of systems and user interfaces for multiple users to interact with virtual user interface objects in a displayed simulated environment, in accordance with some embodiments illustrate example user interfaces for interacting with augmented and virtual reality environments, including displaying an augmented reality environment and, in response to different inputs, adjusting the appearance of the augmented reality environment and/or the appearance of objects in the augmented reality environment, transitioning between viewing a virtual model in the augmented reality environment and viewing simulated views of the virtual model from the perspectives of objects in the virtual model, and three-dimensional manipulation of virtual user interface objects, in accordance with some embodiments. FIGS. 6A-6D illustrate a flow diagram of a method of adjusting an appearance of a virtual user interface object in an augmented reality environment, in accordance with some embodiments. FIGS. 7A-7C illustrate a flow diagram of a method of applying a filter on a live image captured by one or more cameras of a computer system in an augmented reality environment, in accordance with some embodiments. FIGS. 8A-8C illustrate a flow diagram of a method of transitioning between viewing a virtual model in the augmented reality environment and viewing simulated views of the virtual model from the perspectives of objects in the virtual model, in accordance with some embodiments. FIGS. 9A-9E illustrate a flow diagram of a method of three-dimensional manipulation of virtual user interface objects, in accordance with some embodiments. FIGS. 10A-10E illustrate a flow diagram of a method of transitioning between viewing modes of a displayed simulated environment, in accordance with some embodiments. FIGS. 11A-11C illustrate a flow diagram of a method of updating an indication of a viewing perspective of a second computer system in a simulated environment displayed by a first computer system, in accordance with some embodiments. FIGS. 12A-12D illustrate a flow diagram of a method of placement of an insertion cursor, in accordance with some embodiments. FIGS. 13A-13E illustrate a flow diagram of a method of displaying an augmented reality environment in a stabilized mode of operation, in accordance with some embodiments.

[0044] The user interfaces in FIGS. 5A1-5A40, 5B1-5B41, 5C1-5C30, 5D1-5D14, 5E1-5E32, and 5F1-5F17 are used to illustrate the processes in FIGS. 6A-6D, 7A-7C, 8A-8C, 9A-9E, 10A-10E, 11A-11C, 12A-12D, and 13A-13E.

Example Devices

[0045] Reference will now be made in detail to embodiments, examples of which are illustrated in the accompanying drawings. In the following detailed description, numerous specific details are set forth in order to provide a thorough understanding of the various described embodiments. However, it will be apparent to one of ordinary skill in the art that the various described embodiments may be practiced without these specific details. In other instances, well-known methods, procedures, components, circuits, and networks have not been described in detail so as not to unnecessarily obscure aspects of the embodiments.

[0046] It will also be understood that, although the terms first, second, etc. are, in some instances, used herein to describe various elements, these elements should not be limited by these terms. These terms are only used to distinguish one element from another. For example, a first contact could be termed a second contact, and, similarly, a second contact could be termed a first contact, without departing from the scope of the various described embodiments. The first contact and the second contact are both contacts, but they are not the same contact, unless the context clearly indicates otherwise.

[0047] The terminology used in the description of the various described embodiments herein is for the purpose of describing particular embodiments only and is not intended to be limiting. As used in the description of the various described embodiments and the appended claims, the singular forms "a," "an," and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will also be understood that the term "and/or" as used herein refers to and encompasses any and all possible combinations of one or more of the associated listed items. It will be further understood that the terms "includes," "including," "comprises," and/or "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

[0048] As used herein, the term "if" is, optionally, construed to mean "when" or "upon" or "in response to determining" or "in response to detecting," depending on the context. Similarly, the phrase "if it is determined" or "if [a stated condition or event] is detected" is, optionally, construed to mean "upon determining" or "in response to determining" or "upon detecting [the stated condition or event]" or "in response to detecting [the stated condition or event]," depending on the context.

[0049] Computer systems for virtual/augmented reality include electronic devices that produce virtual/augmented reality environments. Embodiments of electronic devices, user interfaces for such devices, and associated processes for using such devices are described. In some embodiments, the device is a portable communications device, such as a mobile telephone, that also contains other functions, such as PDA and/or music player functions. Example embodiments of portable multifunction devices include, without limitation, the iPhone®, iPod Touch®, and iPad® devices from Apple Inc. of Cupertino, Calif. Other portable electronic devices, such as laptops or tablet computers with touch-sensitive surfaces (e.g., touch-screen displays and/or touchpads), are, optionally, used. It should also be understood that, in some embodiments, the device is not a portable communications device, but is a desktop computer with a touch-sensitive surface (e.g., a touch-screen display and/or a touchpad) that also includes, or is in communication with, one or more cameras.

[0050] In the discussion that follows, a computer system that includes an electronic device that has (and/or is in communication with) a display and a touch-sensitive surface is described. It should be understood, however, that the computer system optionally includes one or more other physical user-interface devices, such as a physical keyboard, a mouse, a joystick, a wand controller, and/or cameras tracking the position of one or more features of the user such as the user's hands.

[0051] The device typically supports a variety of applications, such as one or more of the following: a gaming application, a note taking application, a drawing application, a presentation application, a word processing application, a spreadsheet application, a telephone application, a video conferencing application, an e-mail application, an instant messaging application, a workout support application, a photo management application, a digital camera application, a digital video camera application, a web browsing application, a digital music player application, and/or a digital video player application.

[0052] The various applications that are executed on the device optionally use at least one common physical user-interface device, such as the touch-sensitive surface. One or more functions of the touch-sensitive surface as well as corresponding information displayed by the device are, optionally, adjusted and/or varied from one application to the next and/or within a respective application. In this way, a common physical architecture (such as the touch-sensitive surface) of the device optionally supports the variety of applications with user interfaces that are intuitive and transparent to the user.

[0053] Attention is now directed toward embodiments of portable devices with touch-sensitive displays. FIG. **1**A is a block diagram illustrating portable multifunction device **100** with touch-sensitive display system **112** in accordance with some embodiments. Touch-sensitive display system **112** is sometimes called a "touch screen" for convenience, and is sometimes simply called a touch-sensitive display. Device **100** includes memory **102** (which optionally includes one or more computer readable storage mediums), memory controller **122**, one or more processing units (CPUs) **120**, peripherals interface **118**, RF circuitry **108**, audio circuitry **110**, speaker **111**, microphone **113**, input/output (I/O) subsystem **106**, other input or control devices **116**, and external port **124**. Device **100** optionally includes one or more optical sensors **164** (e.g., as part of one or more cameras). Device **100** optionally includes one or more intensity sensors **165** for detecting intensities of contacts on device **100** (e.g., a touch-sensitive surface such as touch-sensitive display system **112** of device **100**). Device **100** optionally includes one or more tactile output generators **163** for generating tactile outputs on device **100** (e.g., generating tactile outputs on a touch-sensitive surface such as touch-sensitive display system **112** of device **100** or touchpad **355** of device **300**). These components optionally communicate over one or more communication buses or signal lines **103**.

[0054] As used in the specification and claims, the term "tactile output" refers to physical displacement of a device relative to a previous position of the device, physical displacement of a component (e.g., a touch-sensitive surface) of a device relative to another component (e.g., housing) of the device, or displacement of the component relative to a center of mass of the device that will be detected by a user with the user's sense of touch. For example, in situations where the device or the component of the device is in contact with a surface of a user that is sensitive to touch (e.g., a finger, palm, or other part of a user's hand), the tactile output generated by the physical displacement will be interpreted by the user as a tactile sensation corresponding to a perceived change in physical characteristics of the device or the component of the device. For example, movement of a touch-sensitive surface (e.g., a touch-sensitive display or trackpad) is, optionally, interpreted by the user as a "down click" or "up click" of a physical actuator button. In some cases, a user will feel a tactile sensation such as an "down click" or "up click" even when there is no movement of a physical actuator button associated with the touch-sensitive surface that is physically pressed (e.g., displaced) by the user's movements. As another example, movement of the touch-sensitive surface is, optionally, interpreted or sensed by the user as "roughness" of the touch-sensitive surface, even when there is no change in smoothness of the touch-sensitive surface. While such interpretations of touch by a user will be subject to the individualized sensory perceptions of the user, there are many sensory perceptions of touch that are common to a large majority of users. Thus, when a tactile output is described as corresponding to a particular sensory perception of a user (e.g., an "up click," a "down click," "roughness"), unless otherwise stated, the generated tactile output corresponds to physical displacement of the device or a component thereof that will generate the described sensory perception for a typical (or average) user. Using tactile outputs to provide haptic feedback to a user enhances the operability of the device and makes the user-device interface more efficient (e.g., by helping the user to provide proper inputs and reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0055] It should be appreciated that device **100** is only one example of a portable multifunction device, and that device **100** optionally has more or fewer components than shown, optionally combines two or more components, or optionally has a different configuration or arrangement of the components. The various components shown in FIG. **1**A are implemented in hardware, software, firmware, or a combination thereof, including one or more signal processing and/or application specific integrated circuits.

[0056] Memory **102** optionally includes high-speed random access memory and optionally also includes non-volatile memory, such as one or more magnetic disk storage devices, flash memory devices, or other non-volatile solid-state memory devices. Access to memory **102** by other components of device **100**, such as CPU(s) **120** and the peripherals interface **118**, is, optionally, controlled by memory controller **122**.

[0057] Peripherals interface **118** can be used to couple input and output peripherals of the device to CPU(s) **120** and memory **102**. The one or more processors **120** run or execute various software programs and/or sets of instructions stored in memory **102** to perform various functions for device **100** and to process data.

[0058] In some embodiments, peripherals interface **118**, CPU(s) **120**, and memory controller **122** are, optionally, implemented on a single chip, such as chip **104**. In some other embodiments, they are, optionally, implemented on separate chips.

[0059] RF (radio frequency) circuitry **108** receives and sends RF signals, also called electromagnetic signals. RF circuitry **108** converts electrical signals to/from electromagnetic signals and communicates with communications networks and other communications devices via the electromagnetic signals. RF circuitry **108** optionally includes well-known circuitry for performing these functions, including but not limited to an antenna system, an RF transceiver, one or more amplifiers, a tuner, one or more oscillators, a digital signal processor, a CODEC chipset, a subscriber identity module (SIM) card, memory, and so forth. RF circuitry **108** optionally communicates with networks, such as the Internet, also referred to as the World Wide Web (WWW), an intranet and/or a wireless network, such as a cellular telephone network, a wireless local area network (LAN) and/or a metropolitan area network (MAN), and other devices by wireless communication. The wireless communication optionally uses any of a plurality of communications standards, protocols and technologies, including but not limited to Global System for Mobile Communications (GSM), Enhanced Data GSM Environment (EDGE), high-speed downlink packet access (HSDPA), high-speed uplink packet access (HSUPA), Evolution, Data-Only (EV-DO), HSPA, HSPA+, Dual-Cell HSPA (DC-HSPA), long term evolution (LTE), near field communication (NFC), wideband code division multiple access (W-CDMA), code division multiple access (CDMA), time division multiple access (TDMA), Bluetooth, Wireless Fidelity (Wi-Fi) (e.g., IEEE 802.11a, IEEE 802.11ac, IEEE 802.11ax, IEEE 802.11b, IEEE 802.11g and/or IEEE 802.1 in), voice over Internet Protocol (VoIP), Wi-MAX, a protocol for e-mail (e.g., Internet message access protocol (IMAP) and/or post office protocol (POP)), instant messaging (e.g., extensible messaging and presence protocol (XMPP), Session Initiation Protocol for Instant Messaging and Presence Leveraging Extensions (SIMPLE), Instant Messaging and Presence Service (IMPS)), and/or Short Message Service (SMS), or any other suitable communication protocol, including communication protocols not yet developed as of the filing date of this document.

[0060] Audio circuitry **110**, speaker **111**, and microphone **113** provide an audio interface between a user and device **100**. Audio circuitry **110** receives audio data from peripherals interface **118**, converts the audio data to an electrical signal, and transmits the electrical signal to speaker **111**. Speaker **111** converts the electrical signal to human-audible sound waves. Audio circuitry **110** also receives electrical signals converted by microphone **113** from sound waves. Audio circuitry **110** converts the electrical signal to audio data and transmits the audio data to peripherals interface **118** for processing. Audio data is, optionally, retrieved from and/or transmitted to memory **102** and/or RF circuitry **108** by peripherals interface **118**. In some embodiments, audio circuitry **110** also includes a headset jack (e.g., **212**, FIG. **2**). The headset jack provides an interface between audio circuitry **110** and removable audio input/output peripherals, such as output-only headphones or a headset with both output (e.g., a headphone for one or both ears) and input (e.g., a microphone).

[0061] I/O subsystem **106** couples input/output peripherals on device **100**, such as touch-sensitive display system

112 and other input or control devices **116**, with peripherals interface **118**. I/O subsystem **106** optionally includes display controller **156**, optical sensor controller **158**, intensity sensor controller **159**, haptic feedback controller **161**, and one or more input controllers **160** for other input or control devices. The one or more input controllers **160** receive/send electrical signals from/to other input or control devices **116**. The other input or control devices **116** optionally include physical buttons (e.g., push buttons, rocker buttons, etc.), dials, slider switches, joysticks, click wheels, and so forth. In some alternate embodiments, input controller(s) **160** are, optionally, coupled with any (or none) of the following: a keyboard, infrared port, USB port, stylus, and/or a pointer device such as a mouse. The one or more buttons (e.g., **208**, FIG. **2**) optionally include an up/down button for volume control of speaker **111** and/or microphone **113**. The one or more buttons optionally include a push button (e.g., **206**, FIG. **2**).

[0062] Touch-sensitive display system **112** provides an input interface and an output interface between the device and a user. Display controller **156** receives and/or sends electrical signals from/to touch-sensitive display system **112**. Touch-sensitive display system **112** displays visual output to the user. The visual output optionally includes graphics, text, icons, video, and any combination thereof (collectively termed "graphics"). In some embodiments, some or all of the visual output corresponds to user interface objects. As used herein, the term "affordance" refers to a user-interactive graphical user interface object (e.g., a graphical user interface object that is configured to respond to inputs directed toward the graphical user interface object). Examples of user-interactive graphical user interface objects include, without limitation, a button, slider, icon, selectable menu item, switch, hyperlink, or other user interface control.

[0063] Touch-sensitive display system **112** has a touch-sensitive surface, sensor or set of sensors that accepts input from the user based on haptic and/or tactile contact. Touch-sensitive display system **112** and display controller **156** (along with any associated modules and/or sets of instructions in memory **102**) detect contact (and any movement or breaking of the contact) on touch-sensitive display system **112** and converts the detected contact into interaction with user-interface objects (e.g., one or more soft keys, icons, web pages or images) that are displayed on touch-sensitive display system **112**. In some embodiments, a point of contact between touch-sensitive display system **112** and the user corresponds to a finger of the user or a stylus.

[0064] Touch-sensitive display system **112** optionally uses LCD (liquid crystal display) technology, LPD (light emitting polymer display) technology, or LED (light emitting diode) technology, although other display technologies are used in other embodiments. Touch-sensitive display system **112** and display controller **156** optionally detect contact and any movement or breaking thereof using any of a plurality of touch sensing technologies now known or later developed, including but not limited to capacitive, resistive, infrared, and surface acoustic wave technologies, as well as other proximity sensor arrays or other elements for determining one or more points of contact with touch-sensitive display system **112**. In some embodiments, projected mutual capacitance sensing technology is used, such as that found in the iPhone®, iPod Touch®, and iPad® from Apple Inc. of Cupertino, Calif.

[0065] Touch-sensitive display system **112** optionally has a video resolution in excess of 100 dpi. In some embodiments, the touch screen video resolution is in excess of 400 dpi (e.g., 500 dpi, 800 dpi, or greater). The user optionally makes contact with touch-sensitive display system **112** using any suitable object or appendage, such as a stylus, a finger, and so forth. In some embodiments, the user interface is designed to work with finger-based contacts and gestures, which can be less precise than stylus-based input due to the larger area of contact of a finger on the touch screen. In some embodiments, the device translates the rough finger-based input into a precise pointer/cursor position or command for performing the actions desired by the user.

[0066] In some embodiments, in addition to the touch screen, device **100** optionally includes a touchpad (not shown) for activating or deactivating particular functions. In some embodiments, the touchpad is a touch-sensitive area of the device that, unlike the touch screen, does not display visual output. The touchpad is, optionally, a touch-sensitive surface that is separate from touch-sensitive display system **112** or an extension of the touch-sensitive surface formed by the touch screen.

[0067] Device **100** also includes power system **162** for powering the various components. Power system **162** optionally includes a power management system, one or more power sources (e.g., battery, alternating current (AC)), a recharging system, a power failure detection circuit, a power converter or inverter, a power status indicator (e.g., a light-emitting diode (LED)) and any other components associated with the generation, management and distribution of power in portable devices.

[0068] Device **100** optionally also includes one or more optical sensors **164** (e.g., as part of one or more cameras). FIG. **1**A shows an optical sensor coupled with optical sensor controller **158** in I/O subsystem **106**. Optical sensor(s) **164** optionally include charge-coupled device (CCD) or complementary metal-oxide semiconductor (CMOS) phototransistors. Optical sensor(s) **164** receive light from the environment, projected through one or more lens, and converts the light to data representing an image. In conjunction with imaging module **143** (also called a camera module), optical sensor(s) **164** optionally capture still images and/or video. In some embodiments, an optical sensor is located on the back of device **100**, opposite touch-sensitive display system **112** on the front of the device, so that the touch screen is enabled for use as a viewfinder for still and/or video image acquisition. In some embodiments, another optical sensor is located on the front of the device so that the user's image is obtained (e.g., for selfies, for videoconferencing while the user views the other video conference participants on the touch screen, etc.).

[0069] Device **100** optionally also includes one or more contact intensity sensors **165**. FIG. **1**A shows a contact intensity sensor coupled with intensity sensor controller **159** in I/O subsystem **106**. Contact intensity sensor(s) **165** optionally include one or more piezoresistive strain gauges, capacitive force sensors, electric force sensors, piezoelectric force sensors, optical force sensors, capacitive touch-sensitive surfaces, or other intensity sensors (e.g., sensors used to measure the force (or pressure) of a contact on a touch-sensitive surface). Contact intensity sensor(s) **165** receive contact intensity information (e.g., pressure information or a proxy for pressure information) from the environment. In some embodiments, at least one contact intensity sensor is collocated with, or proximate to, a touch-sensitive surface (e.g., touch-sensitive display system **112**). In some embodiments, at least one contact intensity sensor is located on the back of device **100**, opposite touch-screen display system **112** which is located on the front of device **100**.

[0070] Device **100** optionally also includes one or more proximity sensors **166**. FIG. **1**A shows proximity sensor **166** coupled with peripherals interface **118**. Alternately, proximity sensor **166** is coupled with input controller **160** in I/O subsystem **106**. In some embodiments, the proximity sensor turns off and disables touch-sensitive display system **112** when the multifunction device is placed near the user's ear (e.g., when the user is making a phone call).

[0071] Device **100** optionally also includes one or more tactile output generators **163**. FIG. **1**A shows a tactile output generator coupled with haptic feedback controller **161** in I/O subsystem **106**. In some embodiments, tactile output generator(s) **163** include one or more electroacoustic devices such as speakers or other audio components and/or electromechanical devices that convert energy into linear motion such as a motor, solenoid, electroactive polymer, piezoelectric actuator, electrostatic actuator, or other tactile output generating component (e.g., a component that converts electrical signals into tactile outputs on the device). Tactile output generator(s) **163** receive tactile feedback generation instructions from haptic feedback module **133** and generates tactile outputs on device **100** that are capable of being sensed by a user of device **100**. In some embodiments, at least one tactile output generator is collocated with, or proximate to, a touch-sensitive surface (e.g., touch-sensitive display system **112**) and, optionally, generates a tactile output by moving the touch-sensitive surface vertically (e.g., in/out of a surface of device **100**) or laterally (e.g., back and forth in the same plane as a surface of device **100**). In some embodiments, at least one tactile output generator sensor is located on the back of device **100**, opposite touch-sensitive display system **112**, which is located on the front of device **100**.

[0072] Device **100** optionally also includes one or more accelerometers **167**, gyroscopes **168**, and/or magnetometers **169** (e.g., as part of an inertial measurement unit (IMU)) for obtaining information concerning the position (e.g., attitude) of the device. FIG. **1**A shows sensors **167**, **168**, and **169** coupled with peripherals interface **118**. Alternately, sensors **167**, **168**, and **169** are, optionally, coupled with an input controller **160** in I/O subsystem **106**. In some embodiments, information is displayed on the touch-screen display in a portrait view or a landscape view based on an analysis of data received from the one or more accelerometers. Device **100** optionally includes a GPS (or GLONASS or other global navigation system) receiver (not shown) for obtaining information concerning the location of device **100**.

[0073] In some embodiments, the software components stored in memory **102** include operating system **126**, communication module (or set of instructions) **128**, contact/motion module (or set of instructions) **130**, graphics module (or set of instructions) **132**, haptic feedback module (or set of instructions) **133**, text input module (or set of instructions) **134**, Global Positioning System (GPS) module (or set of instructions) **135**, and applications (or sets of instructions) **136**. Furthermore, in some embodiments, memory **102** stores device/global internal state **157**, as shown in FIGS. **1**A and **3**. Device/global internal state **157** includes one or more of: active application state, indicating which applications, if any, are currently active; display state, indicating what applications, views or other information occupy various regions of touch-sensitive display system **112**; sensor state, including information obtained from the device's various sensors and other input or control devices **116**; and location and/or positional information concerning the device's location and/or attitude.

[0074] Operating system **126** (e.g., iOS, Android, Darwin, RTXC, LINUX, UNIX, OS X, WINDOWS, or an embedded operating system such as VxWorks) includes various software components and/or drivers for controlling and managing general system tasks (e.g., memory management, storage device control, power management, etc.) and facilitates communication between various hardware and software components.

[0075] Communication module **128** facilitates communication with other devices over one or more external ports **124** and also includes various software components for handling data received by RF circuitry **108** and/or external port **124**. External port **124** (e.g., Universal Serial Bus (USB), FIREWIRE, etc.) is adapted for coupling directly to other devices or indirectly over a network (e.g., the Internet, wireless LAN, etc.). In some embodiments, the external port is a multi-pin (e.g., 30-pin) connector that is the same as, or similar to and/or compatible with the 30-pin connector used in some iPhone®, iPod Touch®, and iPad® devices from Apple Inc. of Cupertino, Calif. In some embodiments, the external port is a Lightning connector that is the same as, or similar to and/or compatible with the Lightning connector used in some iPhone®, iPod Touch®, and iPad® devices from Apple Inc. of Cupertino, Calif. In some embodiments, the external port is a USB Type-C connector that is the same as, or similar to and/or compatible with the USB Type-C connector used in some electronic devices from Apple Inc. of Cupertino, Calif.

[0076] Contact/motion module **130** optionally detects contact with touch-sensitive display system **112** (in conjunction with display controller **156**) and other touch-sensitive devices (e.g., a touchpad or physical click wheel). Contact/motion module **130** includes various software components for performing various operations related to detection of contact (e.g., by a finger or by a stylus), such as determining if contact has occurred (e.g., detecting a finger-down event), determining an intensity of the contact (e.g., the force or pressure of the contact or a substitute for the force or pressure of the contact), determining if there is movement of the contact and tracking the movement across the touch-sensitive surface (e.g., detecting one or more finger-dragging events), and determining if the contact has ceased (e.g., detecting a finger-up event or a break in contact). Contact/motion module **130** receives contact data from the touch-sensitive surface. Determining movement of the point of contact, which is represented by a series of contact data, optionally includes determining speed (magnitude), velocity (magnitude and direction), and/or an acceleration (a change in magnitude and/or direction) of the point of contact. These operations are, optionally, applied to single contacts (e.g., one finger contacts or stylus contacts) or to multiple simultaneous contacts (e.g., "multitouch"/multiple finger contacts). In some embodiments, contact/motion module **130** and display controller **156** detect contact on a touchpad.

[0077] Contact/motion module **130** optionally detects a gesture input by a user. Different gestures on the touch-sensitive surface have different contact patterns (e.g., different motions, timings, and/or intensities of detected contacts). Thus, a gesture is, optionally, detected by detecting a particular contact pattern. For example, detecting a finger tap gesture includes detecting a finger-down event followed by detecting a finger-up (lift off) event at the same position (or substantially the same position) as the finger-down event (e.g., at the position of an icon). As another example, detecting a finger swipe gesture on the touch-sensitive surface includes detecting a finger-down event followed by detecting one or more finger-dragging events, and subsequently followed by detecting a finger-up (lift off) event. Similarly, tap, swipe, drag, and other gestures are optionally detected for a stylus by detecting a particular contact pattern for the stylus.

[0078] In some embodiments, detecting a finger tap gesture depends on the length of time between detecting the finger-down event and the finger-up event, but is independent of the intensity of the finger contact between detecting the finger-down event and the finger-up event. In some embodiments, a tap gesture is detected in accordance with a determination that the length of time between the finger-down event and the finger-up event is less than a predetermined value (e.g., less than 0.1, 0.2, 0.3, 0.4 or 0.5 seconds), independent of whether the intensity of the finger contact during the tap meets a given intensity threshold (greater than a nominal contact-detection intensity threshold), such as a light press or deep press intensity threshold. Thus, a finger tap gesture can satisfy particular input criteria that do not require that the characteristic intensity of a contact satisfy a given intensity threshold in order for the particular input criteria to be met. For clarity, the finger contact in a tap gesture typically needs to satisfy a nominal contact-detection intensity threshold, below which the contact is not detected, in order for the finger-down event to be detected. A similar analysis applies to detecting a tap gesture by a stylus or other contact. In cases where the device is capable of detecting a finger or stylus contact hovering over a touch sensitive surface, the nominal contact-detection intensity threshold optionally does not correspond to physical contact between the finger or stylus and the touch sensitive surface.

[0079] The same concepts apply in an analogous manner to other types of gestures. For example, a swipe gesture, a pinch gesture, a depinch gesture, and/or a long press gesture are optionally detected based on the satisfaction of criteria that are either independent of intensities of contacts included in the gesture, or do not require that contact(s) that perform the gesture reach intensity thresholds in order to be recognized. For example, a swipe gesture is detected based on an amount of movement of one or more contacts; a pinch gesture is detected based on movement of two or more contacts towards each other; a depinch gesture is detected based on movement of two or more contacts away from each other; and a long press gesture is detected based on a duration of the contact on the touch-sensitive surface with less than a threshold amount of movement. As such, the statement that particular gesture recognition criteria do not require that the intensity of the contact(s) meet a respective intensity threshold in order for the particular gesture recognition criteria to be met means that the particular gesture recognition criteria are capable of being satisfied if the contact(s) in the gesture do not reach the respective intensity threshold, and are also capable of being satisfied in circumstances where one or more of the contacts in the gesture do reach or exceed the respective intensity threshold. In some embodiments, a tap gesture is detected based on a determination that the finger-down and finger-up event are detected within a predefined time period, without regard to whether the contact is above or below the respective intensity threshold during the predefined time period, and a swipe gesture is detected based on a determination that the contact movement is greater than a predefined magnitude, even if the contact is above the respective intensity threshold at the end of the contact movement. Even in implementations where detection of a gesture is influenced by the intensity of contacts performing the gesture (e.g., the device detects a long press more quickly when the intensity of the contact is above an intensity threshold or delays detection of a tap input when the intensity of the contact is higher), the detection of those gestures does not require that the contacts reach a particular intensity threshold so long as the criteria for recognizing the gesture can be met in circumstances where the contact does not reach the particular intensity threshold (e.g., even if the amount of time that it takes to recognize the gesture changes).

[0080] Contact intensity thresholds, duration thresholds, and movement thresholds are, in some circumstances, combined in a variety of different combinations in order to create heuristics for distinguishing two or more different gestures directed to the same input element or region so that multiple different interactions with the same input element are enabled to provide a richer set of user interactions and responses. The statement that a particular set of gesture recognition criteria do not require that the intensity of the contact(s) meet a respective intensity threshold in order for the particular gesture recognition criteria to be met does not preclude the concurrent evaluation of other intensity-dependent gesture recognition criteria to identify other gestures that do have a criteria that is met when a gesture includes a contact with an intensity above the respective intensity threshold. For example, in some circumstances, first gesture recognition criteria for a first gesture—which do not require that the intensity of the contact(s) meet a respective intensity threshold in order for the first gesture recognition criteria to be met—are in competition with second gesture recognition criteria for a second gesture—which are dependent on the contact(s) reaching the respective intensity threshold. In such competitions, the gesture is, optionally, not recognized as meeting the first gesture recognition criteria for the first gesture if the second gesture recognition criteria for the second gesture are met first. For example, if a contact reaches the respective intensity threshold before the contact moves by a predefined amount of movement, a deep press gesture is detected rather than a swipe gesture. Conversely, if the contact moves by the predefined amount of movement before the contact reaches the respective intensity threshold, a swipe gesture is detected rather than a deep press gesture. Even in such circumstances, the first gesture recognition criteria for the first gesture still do not require that the intensity of the contact(s) meet a respective intensity threshold in order for the first gesture recognition criteria to be met because if the contact stayed below the respective intensity threshold until an end of the gesture (e.g., a swipe gesture with a contact that does not increase to an intensity above the respective intensity threshold), the gesture would have been recognized by the first gesture recognition criteria as a swipe gesture. As such, particular gesture recognition criteria that do not require that the intensity of the contact(s) meet a respective intensity threshold in order for the particular gesture recognition criteria to be met will (A) in some circumstances ignore the intensity of the contact with respect to the intensity threshold (e.g. for a tap gesture) and/or (B) in some circumstances still be dependent on the intensity of the contact with respect to the intensity threshold in the sense that the particular gesture recognition criteria (e.g., for a long press gesture) will fail if a competing set of intensity-dependent gesture recognition criteria (e.g., for a deep press gesture) recognize an input as corresponding to an intensity-dependent gesture before the particular gesture recognition criteria recognize a gesture corresponding to the input (e.g., for a long press gesture that is competing with a deep press gesture for recognition).

[0081] Attitude module **131**, in conjunction with accelerometers **167**, gyroscopes **168**, and/or magnetometers **169**, optionally detects attitude information concerning the device, such as the device's attitude (e.g., roll, pitch, and/or yaw) in a particular frame of reference. Attitude module **131** includes software components for performing various operations related to detecting the position of the device and detecting changes to the attitude of the device.

[0082] Graphics module **132** includes various known software components for rendering and displaying graphics on touch-sensitive display system **112** or other display, including components for changing the visual impact (e.g., brightness, transparency, saturation, contrast or other visual property) of graphics that are displayed. As used herein, the term "graphics" includes any object that can be displayed to a user, including without limitation text, web pages, icons (such as user-interface objects including soft keys), digital images, videos, animations and the like.

[0083] In some embodiments, graphics module **132** stores data representing graphics to be used. Each graphic is, optionally, assigned a corresponding code. Graphics module **132** receives, from applications etc., one or more codes specifying graphics to be displayed along with, if necessary, coordinate data and other graphic property data, and then generates screen image data to output to display controller **156**.

[0084] Haptic feedback module **133** includes various software components for generating instructions (e.g., instructions used by haptic feedback controller **161**) to produce tactile outputs using tactile output generator(s) **163** at one or more locations on device **100** in response to user interactions with device **100**.

[0085] Text input module **134**, which is, optionally, a component of graphics module **132**, provides soft keyboards for entering text in various applications (e.g., contacts **137**, e-mail **140**, IM **141**, browser **147**, and any other application that needs text input).

[0086] GPS module **135** determines the location of the device and provides this information for use in various applications (e.g., to telephone **138** for use in location-based dialing, to camera **143** as picture/video metadata, and to applications that provide location-based services such as weather widgets, local yellow page widgets, and map/navigation widgets).

[0087] Virtual/augmented reality module **145** provides virtual and/or augmented reality logic to applications **136** that implement augmented reality, and in some embodiments virtual reality, features. Virtual/augmented reality module **145** facilitates superposition of virtual content, such as a virtual user interface object, on a representation of at least a portion of a field of view of the one or more cameras. For example, with assistance from the virtual/augmented reality module **145**, the representation of at least a portion of a field of view of the one or more cameras may include a respective physical object and the virtual user interface object may be displayed at a location, in a displayed augmented reality environment, that is determined based on the respective physical object in the field of view of the one or more cameras or a virtual reality environment that is determined based on the attitude of at least a portion of a computer system (e.g., an attitude of a display device that is used to display the user interface to a user of the computer system).

[0088] Applications **136** optionally include the following modules (or sets of instructions), or a subset or superset thereof:

- **[0089]** contacts module **137** (sometimes called an address book or contact list);
- **[0090]** telephone module **138**;
- **[0091]** video conferencing module **139**;
- **[0092]** e-mail client module **140**;
- **[0093]** instant messaging (IM) module **141**;
- **[0094]** workout support module **142**;
- **[0095]** camera module **143** for still and/or video images;
- **[0096]** image management module **144**;
- **[0097]** browser module **147**;
- **[0098]** calendar module **148**;
- **[0099]** widget modules **149**, which optionally include one or more of: weather widget **149-1**, stocks widget **149-2**, calculator widget **149-3**, alarm clock widget **149-4**, dictionary widget **149-5**, and other widgets obtained by the user, as well as user-created widgets **149-6**;
- **[0100]** widget creator module **150** for making user-created widgets **149-6**;
- **[0101]** search module **151**;
- **[0102]** video and music player module **152**, which is, optionally, made up of a video player module and a music player module;
- **[0103]** notes module **153**;
- **[0104]** map module **154**; and/or
- **[0105]** online video module **155**.

[0106] Examples of other applications **136** that are, optionally, stored in memory **102** include other word processing applications, other image editing applications, drawing applications, presentation applications, JAVA-enabled applications, encryption, digital rights management, voice recognition, and voice replication.

[0107] In conjunction with touch-sensitive display system **112**, display controller **156**, contact module **130**, graphics module **132**, and text input module **134**, contacts module **137** includes executable instructions to manage an address book or contact list (e.g., stored in application internal state **192** of contacts module **137** in memory **102** or memory **370**), including: adding name(s) to the address book; deleting name(s) from the address book; associating telephone number(s), e-mail address(es), physical address(es) or other information with a name; associating an image with a name; categorizing and sorting names; providing telephone numbers and/or e-mail addresses to initiate and/or facilitate communications by telephone **138**, video conference **139**, e-mail **140**, or IM **141**; and so forth.

[0108] In conjunction with RF circuitry **108**, audio circuitry **110**, speaker **111**, microphone **113**, touch-sensitive display system **112**, display controller **156**, contact module

130, graphics module **132**, and text input module **134**, telephone module **138** includes executable instructions to enter a sequence of characters corresponding to a telephone number, access one or more telephone numbers in address book **137**, modify a telephone number that has been entered, dial a respective telephone number, conduct a conversation and disconnect or hang up when the conversation is completed. As noted above, the wireless communication optionally uses any of a plurality of communications standards, protocols and technologies.

[0109] In conjunction with RF circuitry **108**, audio circuitry **110**, speaker **111**, microphone **113**, touch-sensitive display system **112**, display controller **156**, optical sensor(s) **164**, optical sensor controller **158**, contact module **130**, graphics module **132**, text input module **134**, contact list **137**, and telephone module **138**, videoconferencing module **139** includes executable instructions to initiate, conduct, and terminate a video conference between a user and one or more other participants in accordance with user instructions.

[0110] In conjunction with RF circuitry **108**, touch-sensitive display system **112**, display controller **156**, contact module **130**, graphics module **132**, and text input module **134**, e-mail client module **140** includes executable instructions to create, send, receive, and manage e-mail in response to user instructions. In conjunction with image management module **144**, e-mail client module **140** makes it very easy to create and send e-mails with still or video images taken with camera module **143**.

[0111] In conjunction with RF circuitry **108**, touch-sensitive display system **112**, display controller **156**, contact module **130**, graphics module **132**, and text input module **134**, the instant messaging module **141** includes executable instructions to enter a sequence of characters corresponding to an instant message, to modify previously entered characters, to transmit a respective instant message (for example, using a Short Message Service (SMS) or Multimedia Message Service (MMS) protocol for telephony-based instant messages or using XMPP, SIMPLE, Apple Push Notification Service (APNs) or IMPS for Internet-based instant messages), to receive instant messages, and to view received instant messages. In some embodiments, transmitted and/or received instant messages optionally include graphics, photos, audio files, video files and/or other attachments as are supported in a MMS and/or an Enhanced Messaging Service (EMS). As used herein, "instant messaging" refers to both telephony-based messages (e.g., messages sent using SMS or MMS) and Internet-based messages (e.g., messages sent using XMPP, SIMPLE, APNs, or IMPS).

[0112] In conjunction with RF circuitry **108**, touch-sensitive display system **112**, display controller **156**, contact module **130**, graphics module **132**, text input module **134**, GPS module **135**, map module **154**, and video and music player module **152**, workout support module **142** includes executable instructions to create workouts (e.g., with time, distance, and/or calorie burning goals); communicate with workout sensors (in sports devices and smart watches); receive workout sensor data; calibrate sensors used to monitor a workout; select and play music for a workout; and display, store and transmit workout data.

[0113] In conjunction with touch-sensitive display system **112**, display controller **156**, optical sensor(s) **164**, optical sensor controller **158**, contact module **130**, graphics module **132**, and image management module **144**, camera module **143** includes executable instructions to capture still images or video (including a video stream) and store them into memory **102**, modify characteristics of a still image or video, and/or delete a still image or video from memory **102**.

[0114] In conjunction with touch-sensitive display system **112**, display controller **156**, contact module **130**, graphics module **132**, text input module **134**, and camera module **143**, image management module **144** includes executable instructions to arrange, modify (e.g., edit), or otherwise manipulate, label, delete, present (e.g., in a digital slide show or album), and store still and/or video images.

[0115] In conjunction with RF circuitry **108**, touch-sensitive display system **112**, display system controller **156**, contact module **130**, graphics module **132**, and text input module **134**, browser module **147** includes executable instructions to browse the Internet in accordance with user instructions, including searching, linking to, receiving, and displaying web pages or portions thereof, as well as attachments and other files linked to web pages.

[0116] In conjunction with RF circuitry **108**, touch-sensitive display system **112**, display system controller **156**, contact module **130**, graphics module **132**, text input module **134**, e-mail client module **140**, and browser module **147**, calendar module **148** includes executable instructions to create, display, modify, and store calendars and data associated with calendars (e.g., calendar entries, to do lists, etc.) in accordance with user instructions.

[0117] In conjunction with RF circuitry **108**, touch-sensitive display system **112**, display system controller **156**, contact module **130**, graphics module **132**, text input module **134**, and browser module **147**, widget modules **149** are mini-applications that are, optionally, downloaded and used by a user (e.g., weather widget **149-1**, stocks widget **149-2**, calculator widget **149-3**, alarm clock widget **149-4**, and dictionary widget **149-5**) or created by the user (e.g., user-created widget **149-6**). In some embodiments, a widget includes an HTML (Hypertext Markup Language) file, a CSS (Cascading Style Sheets) file, and a JavaScript file. In some embodiments, a widget includes an XML (Extensible Markup Language) file and a JavaScript file (e.g., Yahoo! Widgets).

[0118] In conjunction with RF circuitry **108**, touch-sensitive display system **112**, display system controller **156**, contact module **130**, graphics module **132**, text input module **134**, and browser module **147**, the widget creator module **150** includes executable instructions to create widgets (e.g., turning a user-specified portion of a web page into a widget).

[0119] In conjunction with touch-sensitive display system **112**, display system controller **156**, contact module **130**, graphics module **132**, and text input module **134**, search module **151** includes executable instructions to search for text, music, sound, image, video, and/or other files in memory **102** that match one or more search criteria (e.g., one or more user-specified search terms) in accordance with user instructions.

[0120] In conjunction with touch-sensitive display system **112**, display system controller **156**, contact module **130**, graphics module **132**, audio circuitry **110**, speaker **111**, RF circuitry **108**, and browser module **147**, video and music player module **152** includes executable instructions that allow the user to download and play back recorded music and other sound files stored in one or more file formats, such as MP3 or AAC files, and executable instructions to display, present or otherwise play back videos (e.g., on touch-sensitive display system **112**, or on an external display connected wirelessly or via external port **124**). In some embodiments, device **100** optionally includes the functionality of an MP3 player, such as an iPod (trademark of Apple Inc.).

[0121] In conjunction with touch-sensitive display system **112**, display controller **156**, contact module **130**, graphics module **132**, and text input module **134**, notes module **153** includes executable instructions to create and manage notes, to do lists, and the like in accordance with user instructions.

[0122] In conjunction with RF circuitry **108**, touch-sensitive display system **112**, display system controller **156**, contact module **130**, graphics module **132**, text input module **134**, GPS module **135**, and browser module **147**, map module **154** includes executable instructions to receive, display, modify, and store maps and data associated with maps (e.g., driving directions; data on stores and other points of interest at or near a particular location; and other location-based data) in accordance with user instructions.

[0123] In conjunction with touch-sensitive display system **112**, display system controller **156**, contact module **130**, graphics module **132**, audio circuitry **110**, speaker **111**, RF circuitry **108**, text input module **134**, e-mail client module **140**, and browser module **147**, online video module **155** includes executable instructions that allow the user to access, browse, receive (e.g., by streaming and/or download), play back (e.g., on the touch screen **112**, or on an external display connected wirelessly or via external port **124**), send an e-mail with a link to a particular online video, and otherwise manage online videos in one or more file formats, such as H.264. In some embodiments, instant messaging module **141**, rather than e-mail client module **140**, is used to send a link to a particular online video.

[0124] Each of the above identified modules and applications correspond to a set of executable instructions for performing one or more functions described above and the methods described in this application (e.g., the computer-implemented methods and other information processing methods described herein). These modules (i.e., sets of instructions) need not be implemented as separate software programs, procedures or modules, and thus various subsets of these modules are, optionally, combined or otherwise re-arranged in various embodiments. In some embodiments, memory **102** optionally stores a subset of the modules and data structures identified above. Furthermore, memory **102** optionally stores additional modules and data structures not described above.

[0125] In some embodiments, device **100** is a device where operation of a predefined set of functions on the device is performed exclusively through a touch screen and/or a touchpad. By using a touch screen and/or a touchpad as the primary input control device for operation of device **100**, the number of physical input control devices (such as push buttons, dials, and the like) on device **100** is, optionally, reduced.

[0126] The predefined set of functions that are performed exclusively through a touch screen and/or a touchpad optionally include navigation between user interfaces. In some embodiments, the touchpad, when touched by the user, navigates device **100** to a main, home, or root menu from any user interface that is displayed on device **100**. In such embodiments, a "menu button" is implemented using a touch-sensitive surface. In some other embodiments, the menu button is a physical push button or other physical input control device instead of a touch-sensitive surface.

[0127] FIG. **1B** is a block diagram illustrating example components for event handling in accordance with some embodiments. In some embodiments, memory **102** (in FIG. **1A**) or **370** (FIG. **3A**) includes event sorter **170** (e.g., in operating system **126**) and a respective application **136-1** (e.g., any of the aforementioned applications **136**, **137-155**, **380-390**).

[0128] Event sorter **170** receives event information and determines the application **136-1** and application view **191** of application **136-1** to which to deliver the event information. Event sorter **170** includes event monitor **171** and event dispatcher module **174**. In some embodiments, application **136-1** includes application internal state **192**, which indicates the current application view(s) displayed on touch-sensitive display system **112** when the application is active or executing. In some embodiments, device/global internal state **157** is used by event sorter **170** to determine which application(s) is (are) currently active, and application internal state **192** is used by event sorter **170** to determine application views **191** to which to deliver event information.

[0129] In some embodiments, application internal state **192** includes additional information, such as one or more of: resume information to be used when application **136-1** resumes execution, user interface state information that indicates information being displayed or that is ready for display by application **136-1**, a state queue for enabling the user to go back to a prior state or view of application **136-1**, and a redo/undo queue of previous actions taken by the user.

[0130] Event monitor **171** receives event information from peripherals interface **118**. Event information includes information about a sub-event (e.g., a user touch on touch-sensitive display system **112**, as part of a multi-touch gesture). Peripherals interface **118** transmits information it receives from I/O subsystem **106** or a sensor, such as proximity sensor **166**, accelerometer(s) **167**, and/or microphone **113** (through audio circuitry **110**). Information that peripherals interface **118** receives from I/O subsystem **106** includes information from touch-sensitive display system **112** or a touch-sensitive surface.

[0131] In some embodiments, event monitor **171** sends requests to the peripherals interface **118** at predetermined intervals. In response, peripherals interface **118** transmits event information. In other embodiments, peripheral interface **118** transmits event information only when there is a significant event (e.g., receiving an input above a predetermined noise threshold and/or for more than a predetermined duration).

[0132] In some embodiments, event sorter **170** also includes a hit view determination module **172** and/or an active event recognizer determination module **173**.

[0133] Hit view determination module **172** provides software procedures for determining where a sub-event has taken place within one or more views, when touch-sensitive display system **112** displays more than one view. Views are made up of controls and other elements that a user can see on the display.

[0134] Another aspect of the user interface associated with an application is a set of views, sometimes herein called application views or user interface windows, in which information is displayed and touch-based gestures occur. The application views (of a respective application) in which a touch is detected optionally correspond to programmatic levels within a programmatic or view hierarchy of the application. For example, the lowest level view in which a touch is detected is, optionally, called the hit view, and the set of events that are recognized as proper inputs are, optionally, determined based, at least in part, on the hit view of the initial touch that begins a touch-based gesture.

[0135] Hit view determination module **172** receives information related to sub-events of a touch-based gesture. When an application has multiple views organized in a hierarchy, hit view determination module **172** identifies a hit view as the lowest view in the hierarchy which should handle the sub-event. In most circumstances, the hit view is the lowest level view in which an initiating sub-event occurs (i.e., the first sub-event in the sequence of sub-events that form an event or potential event). Once the hit view is identified by the hit view determination module, the hit view typically receives all sub-events related to the same touch or input source for which it was identified as the hit view.

[0136] Active event recognizer determination module **173** determines which view or views within a view hierarchy should receive a particular sequence of sub-events. In some embodiments, active event recognizer determination module **173** determines that only the hit view should receive a particular sequence of sub-events. In other embodiments, active event recognizer determination module **173** determines that all views that include the physical location of a sub-event are actively involved views, and therefore determines that all actively involved views should receive a particular sequence of sub-events. In other embodiments, even if touch sub-events were entirely confined to the area associated with one particular view, views higher in the hierarchy would still remain as actively involved views.

[0137] Event dispatcher module **174** dispatches the event information to an event recognizer (e.g., event recognizer **180**). In embodiments including active event recognizer determination module **173**, event dispatcher module **174** delivers the event information to an event recognizer determined by active event recognizer determination module **173**. In some embodiments, event dispatcher module **174** stores in an event queue the event information, which is retrieved by a respective event receiver module **182**.

[0138] In some embodiments, operating system **126** includes event sorter **170**. Alternatively, application **136-1** includes event sorter **170**. In yet other embodiments, event sorter **170** is a stand-alone module, or a part of another module stored in memory **102**, such as contact/motion module **130**.

[0139] In some embodiments, application **136-1** includes a plurality of event handlers **190** and one or more application views **191**, each of which includes instructions for handling touch events that occur within a respective view of the application's user interface. Each application view **191** of the application **136-1** includes one or more event recognizers **180**. Typically, a respective application view **191** includes a plurality of event recognizers **180**. In other embodiments, one or more of event recognizers **180** are part of a separate module, such as a user interface kit (not shown) or a higher level object from which application **136-1** inherits methods and other properties. In some embodiments, a respective event handler **190** includes one or more of: data updater **176**, object updater **177**, GUI updater **178**, and/or event data **179** received from event sorter **170**. Event handler **190** optionally utilizes or calls data updater **176**, object updater **177** or GUI updater **178** to update the application internal state **192**. Alternatively, one or more of the application views **191** includes one or more respective event handlers **190**. Also, in some embodiments, one or more of data updater **176**, object updater **177**, and GUI updater **178** are included in a respective application view **191**.

[0140] A respective event recognizer **180** receives event information (e.g., event data **179**) from event sorter **170**, and identifies an event from the event information. Event recognizer **180** includes event receiver **182** and event comparator **184**. In some embodiments, event recognizer **180** also includes at least a subset of: metadata **183**, and event delivery instructions **188** (which optionally include sub-event delivery instructions).

[0141] Event receiver **182** receives event information from event sorter **170**. The event information includes information about a sub-event, for example, a touch or a touch movement. Depending on the sub-event, the event information also includes additional information, such as location of the sub-event. When the sub-event concerns motion of a touch, the event information optionally also includes speed and direction of the sub-event. In some embodiments, events include rotation of the device from one orientation to another (e.g., from a portrait orientation to a landscape orientation, or vice versa), and the event information includes corresponding information about the current orientation (also called device attitude) of the device.

[0142] Event comparator **184** compares the event information to predefined event or sub-event definitions and, based on the comparison, determines an event or sub-event, or determines or updates the state of an event or sub-event. In some embodiments, event comparator **184** includes event definitions **186**. Event definitions **186** contain definitions of events (e.g., predefined sequences of sub-events), for example, event **1** (**187-1**), event **2** (**187-2**), and others. In some embodiments, sub-events in an event **187** include, for example, touch begin, touch end, touch movement, touch cancellation, and multiple touching. In one example, the definition for event **1** (**187-1**) is a double tap on a displayed object. The double tap, for example, comprises a first touch (touch begin) on the displayed object for a predetermined phase, a first lift-off (touch end) for a predetermined phase, a second touch (touch begin) on the displayed object for a predetermined phase, and a second lift-off (touch end) for a predetermined phase. In another example, the definition for event **2** (**187-2**) is a dragging on a displayed object. The dragging, for example, comprises a touch (or contact) on the displayed object for a predetermined phase, a movement of the touch across touch-sensitive display system **112**, and lift-off of the touch (touch end). In some embodiments, the event also includes information for one or more associated event handlers **190**.

[0143] In some embodiments, event definition **187** includes a definition of an event for a respective user-interface object. In some embodiments, event comparator **184** performs a hit test to determine which user-interface object is associated with a sub-event. For example, in an application view in which three user-interface objects are displayed on touch-sensitive display system **112**, when a touch is detected on touch-sensitive display system **112**, event comparator **184** performs a hit test to determine which of the three user-interface objects is associated with the touch (sub-event). If each displayed object is associated with a respective event handler **190**, the event comparator uses the result of the hit test to determine which event handler **190** should be activated. For example, event comparator **184**

selects an event handler associated with the sub-event and the object triggering the hit test.

[0144] In some embodiments, the definition for a respective event **187** also includes delayed actions that delay delivery of the event information until after it has been determined whether the sequence of sub-events does or does not correspond to the event recognizer's event type.

[0145] When a respective event recognizer **180** determines that the series of sub-events do not match any of the events in event definitions **186**, the respective event recognizer **180** enters an event impossible, event failed, or event ended state, after which it disregards subsequent sub-events of the touch-based gesture. In this situation, other event recognizers, if any, that remain active for the hit view continue to track and process sub-events of an ongoing touch-based gesture.

[0146] In some embodiments, a respective event recognizer **180** includes metadata **183** with configurable properties, flags, and/or lists that indicate how the event delivery system should perform sub-event delivery to actively involved event recognizers. In some embodiments, metadata **183** includes configurable properties, flags, and/or lists that indicate how event recognizers interact, or are enabled to interact, with one another. In some embodiments, metadata **183** includes configurable properties, flags, and/or lists that indicate whether sub-events are delivered to varying levels in the view or programmatic hierarchy.

[0147] In some embodiments, a respective event recognizer **180** activates event handler **190** associated with an event when one or more particular sub-events of an event are recognized. In some embodiments, a respective event recognizer **180** delivers event information associated with the event to event handler **190**. Activating an event handler **190** is distinct from sending (and deferred sending) sub-events to a respective hit view. In some embodiments, event recognizer **180** throws a flag associated with the recognized event, and event handler **190** associated with the flag catches the flag and performs a predefined process.

[0148] In some embodiments, event delivery instructions **188** include sub-event delivery instructions that deliver event information about a sub-event without activating an event handler. Instead, the sub-event delivery instructions deliver event information to event handlers associated with the series of sub-events or to actively involved views. Event handlers associated with the series of sub-events or with actively involved views receive the event information and perform a predetermined process.

[0149] In some embodiments, data updater **176** creates and updates data used in application **136-1**. For example, data updater **176** updates the telephone number used in contacts module **137**, or stores a video file used in video and music player module **152**. In some embodiments, object updater **177** creates and updates objects used in application **136-1**. For example, object updater **177** creates a new user-interface object or updates the position of a user-interface object. GUI updater **178** updates the GUI. For example, GUI updater **178** prepares display information and sends it to graphics module **132** for display on a touch-sensitive display.

[0150] In some embodiments, event handler(s) **190** includes or has access to data updater **176**, object updater **177**, and GUI updater **178**. In some embodiments, data updater **176**, object updater **177**, and GUI updater **178** are included in a single module of a respective application **136-1** or application view **191**. In other embodiments, they are included in two or more software modules.

[0151] It shall be understood that the foregoing discussion regarding event handling of user touches on touch-sensitive displays also applies to other forms of user inputs to operate multifunction devices **100** with input-devices, not all of which are initiated on touch screens. For example, mouse movement and mouse button presses, optionally coordinated with single or multiple keyboard presses or holds; contact movements such as taps, drags, scrolls, etc., on touch-pads; pen stylus inputs; inputs based on real-time analysis of video images obtained by one or more cameras; movement of the device; oral instructions; detected eye movements; biometric inputs; and/or any combination thereof are optionally utilized as inputs corresponding to sub-events which define an event to be recognized.

[0152] FIG. **2** illustrates a portable multifunction device **100** having a touch screen (e.g., touch-sensitive display system **112**, FIG. **1**A) in accordance with some embodiments. The touch screen optionally displays one or more graphics within user interface (UI) **200**. In these embodiments, as well as others described below, a user is enabled to select one or more of the graphics by making a gesture on the graphics, for example, with one or more fingers **202** (not drawn to scale in the figure) or one or more styluses **203** (not drawn to scale in the figure). In some embodiments, selection of one or more graphics occurs when the user breaks contact with the one or more graphics. In some embodiments, the gesture optionally includes one or more taps, one or more swipes (from left to right, right to left, upward and/or downward) and/or a rolling of a finger (from right to left, left to right, upward and/or downward) that has made contact with device **100**. In some implementations or circumstances, inadvertent contact with a graphic does not select the graphic. For example, a swipe gesture that sweeps over an application icon optionally does not select the corresponding application when the gesture corresponding to selection is a tap.

[0153] Device **100** optionally also includes one or more physical buttons, such as "home" or menu button **204**. As described previously, menu button **204** is, optionally, used to navigate to any application **136** in a set of applications that are, optionally executed on device **100**. Alternatively, in some embodiments, the menu button is implemented as a soft key in a GUI displayed on the touch-screen display.

[0154] In some embodiments, device **100** includes the touch-screen display, menu button **204** (sometimes called home button **204**), push button **206** for powering the device on/off and locking the device, volume adjustment button(s) **208**, Subscriber Identity Module (SIM) card slot **210**, head set jack **212**, and docking/charging external port **124**. Push button **206** is, optionally, used to turn the power on/off on the device by depressing the button and holding the button in the depressed state for a predefined time interval; to lock the device by depressing the button and releasing the button before the predefined time interval has elapsed; and/or to unlock the device or initiate an unlock process. In some embodiments, device **100** also accepts verbal input for activation or deactivation of some functions through microphone **113**. Device **100** also, optionally, includes one or more contact intensity sensors **165** for detecting intensities of contacts on touch-sensitive display system **112** and/or one or more tactile output generators **163** for generating tactile outputs for a user of device **100**.

[0155] FIG. **3**A is a block diagram of an example multifunction device with a display and a touch-sensitive surface in accordance with some embodiments. Device **300** need not be portable. In some embodiments, device **300** is a gaming system, a laptop computer, a desktop computer, a tablet computer, a multimedia player device, a navigation device, an educational device (such as a child's learning toy), a gaming system, or a control device (e.g., a home or industrial controller). Device **300** typically includes one or more processing units (CPU's) **310**, one or more network or other communications interfaces **360**, memory **370**, and one or more communication buses **320** for interconnecting these components. Communication buses **320** optionally include circuitry (sometimes called a chipset) that interconnects and controls communications between system components. Device **300** includes input/output (I/O) interface **330** comprising display **340**, which is optionally a touch-screen display. I/O interface **330** also optionally includes a keyboard and/or mouse (or other pointing device) **350** and touchpad **355**, tactile output generator **357** for generating tactile outputs on device **300** (e.g., similar to tactile output generator(s) **163** described above with reference to FIG. **1**A), sensors **359** (e.g., optical, acceleration, proximity, touch-sensitive, and/or contact intensity sensors similar to contact intensity sensor(s) **165** described above with reference to FIG. **1**A). Memory **370** includes high-speed random access memory, such as DRAM, SRAM, DDR RAM or other random access solid state memory devices; and optionally includes non-volatile memory, such as one or more magnetic disk storage devices, optical disk storage devices, flash memory devices, or other non-volatile solid state storage devices. Memory **370** optionally includes one or more storage devices remotely located from CPU(s) **310**. In some embodiments, memory **370** stores programs, modules, and data structures analogous to the programs, modules, and data structures stored in memory **102** of portable multifunction device **100** (FIG. **1**A), or a subset thereof. Furthermore, memory **370** optionally stores additional programs, modules, and data structures not present in memory **102** of portable multifunction device **100**. For example, memory **370** of device **300** optionally stores drawing module **380**, presentation module **382**, word processing module **384**, website creation module **386**, disk authoring module **388**, and/or spreadsheet module **390**, while memory **102** of portable multifunction device **100** (FIG. **1**A) optionally does not store these modules.

[0156] Each of the above identified elements in FIG. **3**A are, optionally, stored in one or more of the previously mentioned memory devices. Each of the above identified modules corresponds to a set of instructions for performing a function described above. The above identified modules or programs (e.g., sets of instructions) need not be implemented as separate software programs, procedures or modules, and thus various subsets of these modules are, optionally, combined or otherwise re-arranged in various embodiments. In some embodiments, memory **370** optionally stores a subset of the modules and data structures identified above. Furthermore, memory **370** optionally stores additional modules and data structures not described above.

[0157] FIGS. **3**B-**3**D are block diagrams of example computer systems **301** in accordance with some embodiments.

[0158] In some embodiments, computer system **301** includes and/or is in communication with:

- **[0159]** input device(s) (**302** and/or **307**, e.g., a touch-sensitive surface, such as a touch-sensitive remote control, or a touch-screen display that also serves as the display generation component, a mouse, a joystick, a wand controller, and/or cameras tracking the position of one or more features of the user such as the user's hands);
- **[0160]** virtual/augmented reality logic **303** (e.g., virtual/augmented reality module **145**);
- **[0161]** display generation component(s) (**304** and/or **308**, e.g., a display, a projector, a heads-up display, or the like) for displaying virtual user interface elements to the user;
- **[0162]** camera(s) (e.g., **305** and/or **311**) for capturing images of a field of view of the device, e.g., images that are used to determine placement of virtual user interface elements, determine an attitude of the device, and/or display a portion of the physical environment in which the camera(s) are located; and
- **[0163]** attitude sensor(s) (e.g., **306** and/or **311**) for determining an attitude of the device relative to the physical environment and/or changes in attitude of the device.

[0164] In some computer systems (e.g., **301**-*a* in FIG. **3**B), input device(s) **302**, virtual/augmented reality logic **303**, display generation component(s) **304**, camera(s) **305**; and attitude sensor(s) **306** are all integrated into the computer system (e.g., portable multifunction device **100** in FIGS. **1**A-**1**B or device **300** in FIG. **3** such as a smartphone or tablet).

[0165] In some computer systems (e.g., **301**-*b*), in addition to integrated input device(s) **302**, virtual/augmented reality logic **303**, display generation component(s) **304**, camera(s) **305**; and attitude sensor(s) **306**, the computer system is also in communication with additional devices that are separate from the computer system, such as separate input device(s) **307** such as a touch-sensitive surface, a wand, a remote control, or the like and/or separate display generation component(s) **308** such as virtual reality headset or augmented reality glasses that overlay virtual objects on a physical environment.

[0166] In some computer systems (e.g., **301**-*c* in FIG. **3**C), the input device(s) **307**, display generation component(s) **309**, camera(s) **311**; and/or attitude sensor(s) **312** are separate from the computer system and are in communication with the computer system. In some embodiments, other combinations of components in computer system **301** and in communication with the computer system are used. For example, in some embodiments, display generation component(s) **309**, camera(s) **311**, and attitude sensor(s) **312** are incorporated in a headset that is either integrated with or in communication with the computer system.

[0167] In some embodiments, all of the operations described below with reference to FIGS. **5**A**1**-**5**A**40** and **5**B**1**-**5**B**41** are performed on a single computing device with virtual/augmented reality logic **303** (e.g., computer system **301**-*a* described below with reference to FIG. **3**B). However, it should be understood that frequently multiple different computing devices are linked together to perform the operations described below with reference to FIGS. **5**A**1**-**5**A**40** and **5**B **1**-**5**B**41** (e.g., a computing device with virtual/augmented reality logic **303** communicates with a separate computing device with a display **450** and/or a separate computing device with a touch-sensitive surface **451**). In any of these embodiments, the computing device that is described below with reference to FIGS. **5A1-5A40** and **5B 1-5B41** is the computing device (or devices) that contain(s) the virtual/augmented reality logic **303**. Additionally, it should be understood that the virtual/augmented reality logic **303** could be divided between a plurality of distinct modules or computing devices in various embodiments; however, for the purposes of the description herein, the virtual/augmented reality logic **303** will be primarily referred to as residing in a single computing device so as not to unnecessarily obscure other aspects of the embodiments.

[0168] In some embodiments, the virtual/augmented reality logic **303** includes one or more modules (e.g., one or more event handlers **190**, including one or more object updaters **177** and one or more GUI updaters **178** as described in greater detail above with reference to FIG. **1**B) that receive interpreted inputs and, in response to these interpreted inputs, generate instructions for updating a graphical user interface in accordance with the interpreted inputs which are subsequently used to update the graphical user interface on a display. In some embodiments, an interpreted input for an input that has been detected (e.g., by a contact motion module **130** in FIGS. **1**A and **3**), recognized (e.g., by an event recognizer **180** in FIG. **1**B) and/or distributed (e.g., by event sorter **170** in FIG. **1**B) is used to update the graphical user interface on a display. In some embodiments, the interpreted inputs are generated by modules at the computing device (e.g., the computing device receives raw contact input data so as to identify gestures from the raw contact input data). In some embodiments, some or all of the interpreted inputs are received by the computing device as interpreted inputs (e.g., a computing device that includes the touch-sensitive surface **451** processes raw contact input data so as to identify gestures from the raw contact input data and sends information indicative of the gestures to the computing device that includes the virtual/augmented reality logic **303**).

[0169] In some embodiments, both a display and a touch-sensitive surface are integrated with the computer system (e.g., **301**-*a* in FIG. **3**B) that contains the virtual/augmented reality logic **303**. For example, the computer system may be a desktop computer or laptop computer with an integrated display (e.g., **340** in FIG. **3**) and touchpad (e.g., **355** in FIG. **3**). As another example, the computing device may be a portable multifunction device **100** (e.g., a smartphone, PDA, tablet computer, etc.) with a touch screen (e.g., **112** in FIG. **2**).

[0170] In some embodiments, a touch-sensitive surface is integrated with the computer system while a display is not integrated with the computer system that contains the virtual/augmented reality logic **303**. For example, the computer system may be a device **300** (e.g., a desktop computer or laptop computer) with an integrated touchpad (e.g., **355** in FIG. **3**) connected (via wired or wireless connection) to a separate display (e.g., a computer monitor, television, etc.). As another example, the computer system may be a portable multifunction device **100** (e.g., a smartphone, PDA, tablet computer, etc.) with a touch screen (e.g., **112** in FIG. **2**) connected (via wired or wireless connection) to a separate display (e.g., a computer monitor, television, etc.).

[0171] In some embodiments, a display is integrated with the computer system while a touch-sensitive surface is not integrated with the computer system that contains the virtual/augmented reality logic **303**. For example, the computer system may be a device **300** (e.g., a desktop computer, laptop computer, television with integrated set-top box) with an integrated display (e.g., **340** in FIG. **3**) connected (via wired or wireless connection) to a separate touch-sensitive surface (e.g., a remote touchpad, a portable multifunction device, etc.). As another example, the computer system may be a portable multifunction device **100** (e.g., a smartphone, PDA, tablet computer, etc.) with a touch screen (e.g., **112** in FIG. **2**) connected (via wired or wireless connection) to a separate touch-sensitive surface (e.g., a remote touchpad, another portable multifunction device with a touch screen serving as a remote touchpad, etc.).

[0172] In some embodiments, neither a display nor a touch-sensitive surface is integrated with the computer system (e.g., **301**-*c* in FIG. **3**C) that contains the virtual/augmented reality logic **303**. For example, the computer system may be a stand-alone computing device **300** (e.g., a set-top box, gaming console, etc.) connected (via wired or wireless connection) to a separate touch-sensitive surface (e.g., a remote touchpad, a portable multifunction device, etc.) and a separate display (e.g., a computer monitor, television, etc.).

[0173] In some embodiments, the computer system has an integrated audio system (e.g., audio circuitry **110** and speaker **111** in portable multifunction device **100**). In some embodiments, the computing device is in communication with an audio system that is separate from the computing device. In some embodiments, the audio system (e.g., an audio system integrated in a television unit) is integrated with a separate display. In some embodiments, the audio system (e.g., a stereo system) is a stand-alone system that is separate from the computer system and the display.

[0174] Attention is now directed towards embodiments of user interfaces ("UI") that are, optionally, implemented on portable multifunction device **100**.

[0175] FIG. **4**A illustrates an example user interface for a menu of applications on portable multifunction device **100** in accordance with some embodiments. Similar user interfaces are, optionally, implemented on device **300**. In some embodiments, user interface **400** includes the following elements, or a subset or superset thereof:

- **[0176]** Signal strength indicator(s) for wireless communication(s), such as cellular and Wi-Fi signals;
- **[0177]** Time;
- **[0178]** a Bluetooth indicator;
- **[0179]** a Battery status indicator;
- **[0180]** Tray **408** with icons for frequently used applications, such as:
  - **[0181]** Icon **416** for telephone module **138**, labeled "Phone," which optionally includes an indicator **414** of the number of missed calls or voicemail messages;
  - **[0182]** Icon **418** for e-mail client module **140**, labeled "Mail," which optionally includes an indicator **410** of the number of unread e-mails;
  - **[0183]** Icon **420** for browser module **147**, labeled "Browser"; and
  - **[0184]** Icon **422** for video and music player module **152**, labeled "Music"; and
- **[0185]** Icons for other applications, such as:
  - **[0186]** Icon **424** for IM module **141**, labeled "Messages";
  - **[0187]** Icon **426** for calendar module **148**, labeled "Calendar";

[0188] Icon **428** for image management module **144**, labeled "Photos";

[0189] Icon **430** for camera module **143**, labeled "Camera";

[0190] Icon **432** for online video module **155**, labeled "Online Video";

[0191] Icon **434** for stocks widget **149-2**, labeled "Stocks";

[0192] Icon **436** for map module **154**, labeled "Maps";

[0193] Icon **438** for weather widget **149-1**, labeled "Weather";

[0194] Icon **440** for alarm clock widget **149-4**, labeled "Clock";

[0195] Icon **442** for workout support module **142**, labeled "Workout Support";

[0196] Icon **444** for notes module **153**, labeled "Notes"; and

[0197] Icon **446** for a settings application or module, labeled "Settings," which provides access to settings for device **100** and its various applications **136**.

[0198] It should be noted that the icon labels illustrated in FIG. **4**A are merely examples. For example, other labels are, optionally, used for various application icons. In some embodiments, a label for a respective application icon includes a name of an application corresponding to the respective application icon. In some embodiments, a label for a particular application icon is distinct from a name of an application corresponding to the particular application icon.

[0199] FIG. **4**B illustrates an example user interface on a device (e.g., device **300**, FIG. **3**A) with a touch-sensitive surface **451** (e.g., a tablet or touchpad **355**, FIG. **3**A) that is separate from the display **450**. Although many of the examples that follow will be given with reference to inputs on touch screen display **112** (where the touch sensitive surface and the display are combined), in some embodiments, the device detects inputs on a touch-sensitive surface that is separate from the display, as shown in FIG. **4**B. In some embodiments, the touch-sensitive surface (e.g., **451** in FIG. **4**B) has a primary axis (e.g., **452** in FIG. **4**B) that corresponds to a primary axis (e.g., **453** in FIG. **4**B) on the display (e.g., **450**). In accordance with these embodiments, the device detects contacts (e.g., **460** and **462** in FIG. **4**B) with the touch-sensitive surface **451** at locations that correspond to respective locations on the display (e.g., in FIG. **4**B, **460** corresponds to **468** and **462** corresponds to **470**). In this way, user inputs (e.g., contacts **460** and **462**, and movements thereof) detected by the device on the touch-sensitive surface (e.g., **451** in FIG. **4**B) are used by the device to manipulate the user interface on the display (e.g., **450** in FIG. **4**B) of the multifunction device when the touch-sensitive surface is separate from the display. It should be understood that similar methods are, optionally, used for other user interfaces described herein.

[0200] Additionally, while the following examples are given primarily with reference to finger inputs (e.g., finger contacts, finger tap gestures, finger swipe gestures, etc.), it should be understood that, in some embodiments, one or more of the finger inputs are replaced with input from another input device (e.g., a mouse based input or a stylus input). For example, a swipe gesture is, optionally, replaced with a mouse click (e.g., instead of a contact) followed by movement of the cursor along the path of the swipe (e.g., instead of movement of the contact). As another example, a tap gesture is, optionally, replaced with a mouse click while the cursor is located over the location of the tap gesture (e.g., instead of detection of the contact followed by ceasing to detect the contact). Similarly, when multiple user inputs are simultaneously detected, it should be understood that multiple computer mice are, optionally, used simultaneously, or a mouse and finger contacts are, optionally, used simultaneously.

[0201] As used herein, the term "focus selector" refers to an input element that indicates a current part of a user interface with which a user is interacting. In some implementations that include a cursor or other location marker, the cursor acts as a "focus selector," so that when an input (e.g., a press input) is detected on a touch-sensitive surface (e.g., touchpad **355** in FIG. **3**A or touch-sensitive surface **451** in FIG. **4**B) while the cursor is over a particular user interface element (e.g., a button, window, slider or other user interface element), the particular user interface element is adjusted in accordance with the detected input. In some implementations that include a touch-screen display (e.g., touch-sensitive display system **112** in FIG. **1**A or the touch screen in FIG. **4**A) that enables direct interaction with user interface elements on the touch-screen display, a detected contact on the touch-screen acts as a "focus selector," so that when an input (e.g., a press input by the contact) is detected on the touch-screen display at a location of a particular user interface element (e.g., a button, window, slider or other user interface element), the particular user interface element is adjusted in accordance with the detected input. In some implementations, focus is moved from one region of a user interface to another region of the user interface without corresponding movement of a cursor or movement of a contact on a touch-screen display (e.g., by using a tab key or arrow keys to move focus from one button to another button); in these implementations, the focus selector moves in accordance with movement of focus between different regions of the user interface. Without regard to the specific form taken by the focus selector, the focus selector is generally the user interface element (or contact on a touch-screen display) that is controlled by the user so as to communicate the user's intended interaction with the user interface (e.g., by indicating, to the device, the element of the user interface with which the user is intending to interact). For example, the location of a focus selector (e.g., a cursor, a contact, or a selection box) over a respective button while a press input is detected on the touch-sensitive surface (e.g., a touchpad or touch screen) will indicate that the user is intending to activate the respective button (as opposed to other user interface elements shown on a display of the device). In some embodiments, a focus indicator (e.g., a cursor or selection indicator) is displayed via the display device to indicate a current portion of the user interface that will be affected by inputs received from the one or more input devices.

[0202] In some embodiments, the response of the device to inputs detected by the device depends on criteria based on the contact intensity during the input. For example, for some "light press" inputs, the intensity of a contact exceeding a first intensity threshold during the input triggers a first response. In some embodiments, the response of the device to inputs detected by the device depends on criteria that include both the contact intensity during the input and time-based criteria. For example, for some "deep press" inputs, the intensity of a contact exceeding a second intensity threshold during the input, greater than the first intensity threshold for a light press, triggers a second response only if a delay time has elapsed between meeting the first intensity threshold and meeting the second intensity threshold. This delay time is typically less than 200 ms (milliseconds) in duration (e.g., 40, 100, or 120 ms, depending on the magnitude of the second intensity threshold, with the delay time increasing as the second intensity threshold increases). This delay time helps to avoid accidental recognition of deep press inputs. As another example, for some "deep press" inputs, there is a reduced-sensitivity time period that occurs after the time at which the first intensity threshold is met. During the reduced-sensitivity time period, the second intensity threshold is increased. This temporary increase in the second intensity threshold also helps to avoid accidental deep press inputs. For other deep press inputs, the response to detection of a deep press input does not depend on time-based criteria.

[0203] In some embodiments, one or more of the input intensity thresholds and/or the corresponding outputs vary based on one or more factors, such as user settings, contact motion, input timing, application running, rate at which the intensity is applied, number of concurrent inputs, user history, environmental factors (e.g., ambient noise), focus selector position, and the like. Example factors are described in U.S. patent application Ser. Nos. 14/399,606 and 14/624,296, which are incorporated by reference herein in their entireties.

[0204] For example, FIG. **4**C illustrates a dynamic intensity threshold **480** that changes over time based in part on the intensity of touch input **476** over time. Dynamic intensity threshold **480** is a sum of two components, first component **474** that decays over time after a predefined delay time **p1** from when touch input **476** is initially detected, and second component **478** that trails the intensity of touch input **476** over time. The initial high intensity threshold of first component **474** reduces accidental triggering of a "deep press" response, while still allowing an immediate "deep press" response if touch input **476** provides sufficient intensity. Second component **478** reduces unintentional triggering of a "deep press" response by gradual intensity fluctuations of in a touch input. In some embodiments, when touch input **476** satisfies dynamic intensity threshold **480** (e.g., at point **481** in FIG. **4**C), the "deep press" response is triggered.

[0205] FIG. **4**D illustrates another dynamic intensity threshold **486** (e.g., intensity threshold IT_D). FIG. **4**D also illustrates two other intensity thresholds: a first intensity threshold IT_H and a second intensity threshold IT_L. In FIG. **4**D, although touch input **484** satisfies the first intensity threshold IT_H and the second intensity threshold IT_L prior to time **p2**, no response is provided until delay time **p2** has elapsed at time **482**. Also in FIG. **4**D, dynamic intensity threshold **486** decays over time, with the decay starting at time **488** after a predefined delay time **p1** has elapsed from time **482** (when the response associated with the second intensity threshold IT_L was triggered). This type of dynamic intensity threshold reduces accidental triggering of a response associated with the dynamic intensity threshold IT_D immediately after, or concurrently with, triggering a response associated with a lower intensity threshold, such as the first intensity threshold IT_H or the second intensity threshold IT_L.

[0206] FIG. **4**E illustrate yet another dynamic intensity threshold **492** (e.g., intensity threshold IT_D). In FIG. **4**E, a response associated with the intensity threshold IT_L is triggered after the delay time **p2** has elapsed from when touch input **490** is initially detected. Concurrently, dynamic intensity threshold **492** decays after the predefined delay time **p1** has elapsed from when touch input **490** is initially detected. So a decrease in intensity of touch input **490** after triggering the response associated with the intensity threshold IT_L, followed by an increase in the intensity of touch input **490**, without releasing touch input **490**, can trigger a response associated with the intensity threshold IT_D (e.g., at time **494**) even when the intensity of touch input **490** is below another intensity threshold, for example, the intensity threshold IT_L.

User Interfaces and Associated Processes

[0207] Attention is now directed towards embodiments of user interfaces ("UI") and associated processes that may be implemented on a computer system (e.g., portable multifunction device **100** or device **300**) that includes (and/or is in communication with) a display generation component (e.g., a display, a projector, a heads-up display, or the like), one or more cameras (e.g., video cameras that continuously provide a live preview of at least a portion of the contents that are within the field of view of the cameras and optionally generate video outputs including one or more streams of image frames capturing the contents within the field of view of the cameras), and one or more input devices (e.g., a touch-sensitive surface, such as a touch-sensitive remote control, or a touch-screen display that also serves as the display generation component, a mouse, a joystick, a wand controller, and/or cameras tracking the position of one or more features of the user such as the user's hands), optionally one or more attitude sensors, optionally one or more sensors to detect intensities of contacts with the touch-sensitive surface, and optionally one or more tactile output generators.

[0208] FIGS. **5A1-5A40** illustrate example user interfaces for displaying an augmented reality environment and, in response to different inputs, adjusting the appearance of the augmented reality environment and/or the appearance of objects in the augmented reality environment, as well as transitioning between viewing a virtual model in the augmented reality environment and viewing simulated views of the virtual model from the perspectives of objects in the virtual model, in accordance with some embodiments. The user interfaces in these figures are used to illustrate the processes described below, including the processes in FIGS. **6**A-**6**D, **7**A-**7**C, and **8**A-**8**C. For convenience of explanation, some of the embodiments will be discussed with reference to operations performed on a device with a touch-sensitive display system **112**. Similarly, analogous operations are, optionally, performed on a computer system (e.g., as shown in FIG. **5A2**) with a headset **5008** and a separate input device **5010** with a touch-sensitive surface in response to detecting the contacts on the touch-sensitive surface of the input device **5010** while displaying the user interfaces shown in the figures on the display of headset **5008**, along with a focus indicator.

[0209] FIGS. **5A1-5A27** illustrate example user interfaces for displaying an augmented reality environment and, in response to different inputs, adjusting the appearance of the augmented reality environment and/or the appearance of objects in the augmented reality environment, in accordance with some embodiments.

[0210] FIGS. **5A1**-**5A2** illustrate a context in which user interfaces described with regard to **5A3**-**5A40** are used.

[0211] FIG. **5A1** illustrates a physical space in which user **5002**, table **5004**, and a physical building model **5006** are located. User **5002** holds device **100** to view physical building model **5006** through the display of device **100** (e.g., on touch-sensitive display system **112**, sometimes referred to as "touch-screen display **112**," "touch screen **112**," "display **112**" or "touch-sensitive display **112**," of device **100**, as shown in FIGS. 1A, **4**A, **5**A4). One or more cameras of device **100** (sometimes referred to as "a camera" of device **100**) continuously provide a live preview of the contents that are within the field of view of the cameras, including one or more physical objects in the physical space (e.g., wallpaper **5007** in the room of the physical space, table **5004**, etc.). Device **100** displays an augmented reality environment that includes a representation of at least a portion of the field of view of the cameras that includes a physical object (e.g., physical building model **5006**) and one or more virtual objects (e.g., a virtual model of the building covering the physical building model **5006**, virtual trees, etc.), and user **5002** uses the touch-screen display of device **100** to interact with the augmented reality environment.

[0212] FIG. **5A2** illustrates an alternative method in which user **5002** views physical building model **5006** using a computer system that includes a headset **5008** and a separate input device **5010** with a touch-sensitive surface. In this example, headset **5008** displays the augmented reality environment and user **5002** uses the separate input device **5010** to interact with the augmented reality environment. In some embodiments, device **100** is used as the separate input device **5010**. In some embodiments, the separate input device **5010** is a touch-sensitive remote control, a mouse, a joystick, a wand controller, or the like. In some embodiments, the separate input device **5010** includes one or more cameras that track the position of one or more features of user **5002** such as the user's hands and movement.

[0213] FIGS. **5A3**-**5A4** illustrate a view of an augmented reality environment displayed on touch screen **112** of device **100**. FIG. **5A3** illustrates the position of device **100**, in relation to table **5004** and physical building model **5006**, from the perspective of user **5002**. FIG. **5A4** shows a closer view of device **100** from FIG. **5A3**. Device **100** displays an augmented reality environment including a live view of the physical space as captured by the camera of device **100** and a virtual user interface object (virtual building model **5012**). Here, virtual building model **5012** is a 3D virtual model of the physical building model **5006** that appears to be attached to, or cover, the physical building model **5006** in the field of view of the camera (e.g., replacing the physical building model **5006** in the augmented reality environment). The displayed augmented reality environment also includes virtual objects that do not correspond to physical objects in the field of view of the camera (e.g., virtual trees, virtual bushes, a virtual person, and a virtual car) and physical objects that are in the field of view of the camera (e.g., wallpaper **5007**). In some embodiments, device **100** displays one or more buttons (e.g., button **5014**, button **5016**, and button **5018**, sometimes called virtual buttons or displayed buttons) for interacting with the augmented reality environment (e.g., as discussed below with respect to FIGS. **5A25**-**5A27**).

[0214] FIGS. **5A5**-**5A6** illustrate a different view of the augmented reality environment displayed on touch screen **112** of device **100**, after user **5002** has moved from the front of table **5004** (e.g., as shown in FIG. **5A3**) to the side of table **5004** (e.g., as shown in FIG. **5A5**). FIG. **5A5** illustrates the position of device **100**, in relation to table **5004** and physical building model **5006**, from the perspective of user **5002**. FIG. **5A6** shows a closer view of device **100** from FIG. **5A5**. As shown in FIGS. **5A5**-**5A6**, virtual building model **5012** remains anchored to physical building model **5006**, and the view of virtual building model **5012** changes as the location, shape, and/or orientation of physical building model **5006** changes in the field of view of the camera.

[0215] FIGS. **5A7**-**5A14** illustrate adjusting an appearance of virtual building model **5012** in the augmented reality environment based on a combination of movement of a contact on touch screen **112** and movement of device **100**. Reference box **5019** illustrates the position of device **100**, in relation to table **5004** and physical building model **5006**, from the perspective of user **5002**.

[0216] In FIG. **5A7**, device **100** displays an augmented reality environment when device **100** is in a first position relative to table **5004** and physical building model **5006** (e.g., as shown in reference box **5019**). In FIG. **5A8**, device **100** detects an input on virtual building model **5012** (e.g., by detecting a touch input by contact **5020**-*a* on the roof of virtual building model **5012**). In FIGS. **5A9**-**5A11**, while continuing to detect the input (e.g., while contact **5020** is maintained on touch screen **112**), device **100** detects movement of the input relative to physical building model **5006** (e.g., a drag gesture by contact **5020**) and adjusts the appearance of virtual building model **5012** (e.g., lifting virtual roof **5012**-*a* up from the virtual building model) in accordance with a magnitude of movement of the input relative to physical building model **5006**. In FIG. **5A9**, when contact **5020**-*b* has moved a relatively small amount, virtual roof **5012**-*a* is lifted by a corresponding small amount. In FIG. **5A10**, when contact **5020**-*c* has moved a larger amount, virtual roof **5012**-*a* is lifted by a corresponding larger amount. In some embodiments, as shown in FIG. **5A 1**, as virtual roof **5012**-*a* continues to lift up, floors of the virtual building model **5012** lift up and expand (e.g., showing virtual first floor **5012**-*d*, virtual second floor **5012**-*c*, and virtual third floor **5012**-*b*). As shown in FIGS. **5A9**-**5A11**, as contact **5020** moves up, device **100** updates the display of virtual building model **5012** so as to maintain display of the initial contact point on virtual roof **5012**-*a* at the location of contact **5020**.

[0217] In FIGS. **5A12**-**5A13**, while contact **5020**-*d* is maintained and kept stationary on touch screen **112**, device **100** detects movement of device **100** in physical space (e.g., movement **5022**, from a first position that is lower relative to physical building model **5006**, as shown in reference box **5019** in FIG. **5A12**, to a second position that is higher relative to physical building model **5006**, as shown in reference box **5019** in FIG. **5A13**). In response to the movement of the input (from movement of device **100** in physical space), device **100** adjusts the appearance of virtual building model **5012** by lifting virtual roof **5012**-*a* further up in accordance with the magnitude of the movement. In some embodiments, as shown in FIG. **5A13**, the virtual roof **5012**-*a* is displayed at a location beyond a maximum limit of the resting state of virtual roof **5012**-*a* when the appearance of virtual model **5012** is adjusted in accordance with the magnitude of the movement.

[0218] In FIG. **5A14**, device **100** ceases to detect the input (e.g., contact **5020** lifts off) and displays virtual roof **5012**-*a* at a location corresponding to the maximum limit of the resting state. In some embodiments, device **100** displays an animated transition (e.g., from FIG. **5A13** to FIG. **5A14**) from the virtual roof **5012**-*a* at the location beyond the maximum limit of the resting state (e.g., in FIG. **5A13**) to the location corresponding to the maximum limit of the resting state (e.g., in FIG. **5A14**).

[0219] FIGS. **5A15-5A16** illustrate movement of device **100** in physical space (e.g., movement **5024**) when no input is detected on touch screen **112** (e.g., no touch input by a contact is detected on touch screen **112**). Since no input is detected, movement of device **100** changes the field of view of the camera of device **100** from a first position that is lower relative to physical building model **5006** (e.g., as shown in reference box **5019** in FIG. **5A15**) to a second position that is higher relative to physical building model **5006** (e.g., as shown in reference box **5019** in FIG. **5A16**), without adjusting the appearance of virtual building model **5012**.

[0220] In contrast to FIGS. **5A15-5A16**, FIGS. **5A17-5A18** illustrate movement of device **100** in physical space (e.g., movement **5028**) when an input is detected on touch screen **112** (e.g., touch input by contact **5026**-*a* is detected on touch screen **112**). While continuing to detect the input (e.g., while contact **5026**-*a* is maintained and kept stationary on touch screen **112**), device **100** detects movement of device **100** in physical space (from a first position that is lower relative to physical building model **5006**, as shown in reference box **5019** in FIG. **5A17**, to a second position that is higher relative to physical building model **5006**, as shown in reference box **5019** in FIG. **5A18**). In response to the movement of the input (from movement of device **100** in physical space), device **100** adjusts the appearance of virtual building model **5012** by lifting virtual roof **5012**-*a* up in accordance with the magnitude of the movement.

[0221] In FIGS. **5A19-5A20**, while continuing to detect the input (e.g., while contact **5026** is maintained on touch screen **112**), device **100** detects movement of the input relative to physical building model **5006** (e.g., a drag gesture by contact **5026**) and adjusts the appearance of virtual building model **5012** (e.g., lifting virtual roof **5012**-*a* up further from the virtual building model **5012**) in accordance with a magnitude of movement of the input relative to physical building model **5006**. In some embodiments, as shown in FIG. **5A20**, as virtual roof **5012**-*a* continues to lift up, floors of the virtual building model **5012** lift up and expand (e.g., showing first floor **5012**-*d*, second floor **5012**-*c*, and third floor **5012**-*b*).

[0222] As shown in FIGS. **5A17-5A20**, as the input moves up (whether the movement of the input is due to movement of device **100** while the contact (e.g., contact **5026**-*a*) is maintained and kept stationary on touch screen **112** or whether the movement of the input is due to movement of the contact across touch screen **112** while device **100** is held substantially stationary in the physical space), device **100** updates the display of virtual building model **5012** so as to maintain display of the initial contact point on virtual roof **5012**-*a* at the location of contact **5026**.

[0223] FIGS. **5A21-5A24** illustrate changing a virtual environment setting (e.g., time of day) for the augmented reality environment in response to an input to navigate through time in the augmented reality environment. In FIGS. **5A21-5A24**, device **100** detects an input (e.g., a swipe gesture from left to right by contact **5030**) that changes the virtual environment setting and in response, device **100** changes the time of day in the augmented reality environment (e.g., by adjusting the appearance of virtual building model **5012** and applying a filter to the portion of the representation of the field of view of the camera that is not obscured by virtual building model **5012**). In FIG. **5A21**, the time of day in the augmented reality environment is morning, with the shadows of virtual building model **5012** and the shadows of virtual objects (e.g., virtual trees, virtual bushes, a virtual person, and a virtual car) to the right of the objects. As contact **5030** moves from left to right, the time of day in the augmented reality environment changes from morning to night (e.g., in accordance with the speed and/or distance of the input movement) (e.g., changing from morning in FIG. **5A21** to midday in FIG. **5A22** to afternoon in **5A23** to night in FIG. **5A24**). In some embodiments, device **100** applies a filter to the portions of the live view that are not obscured by the virtual scene (e.g., to wallpaper **5007**) in addition to adjusting the appearance of the virtual scene. For example, in FIG. **5A24** (e.g., when the virtual environment setting is changed to night mode), a different filter is applied to wallpaper **5007** (e.g., illustrated by a first shading pattern) in addition to adjusting the appearance of the virtual scene for night mode (e.g., illustrated by a second shading pattern).

[0224] FIGS. **5A25-5A27** illustrate changing the virtual environment setting for the augmented reality environment in response to an input (e.g., a tap input on a displayed button) that switches between different virtual environments for the virtual user interface object (e.g., virtual building model **5012**), where different virtual environments are associated with different interactions for exploring the virtual user interface object (e.g., predefined virtual environments such as landscape view, interior view, day/night view). In FIG. **5A25**, landscape button **5014** is selected, and the landscape view for virtual building model **5012** is displayed (e.g., with virtual trees, virtual bushes, a virtual person, and a virtual car). In FIGS. **5A26-5A27**, device **100** detects an input on interior button **5016**, such as a tap gesture by contact **5032**, and in response, displays the interior view for virtual building model **5012** (e.g., with no virtual trees, no virtual bushes, no virtual person, and no virtual car, but instead showing an expanded view of virtual building model **5012** with virtual first floor **5012**-*d*, virtual second floor **5012**-*c*, virtual third floor **5012**-*b*, and virtual roof **5012**-*a*). In some embodiments, when the virtual environment setting is changed (e.g., to the interior view), the surrounding physical environment is blurred out (e.g., using a filter). For example, although not shown in FIG. **5A27**, in some embodiments, wallpaper **5007** is blurred out when the virtual environment setting is changed to the interior view.

[0225] FIGS. **5A28-5A40** illustrate example user interfaces for transitioning between viewing a virtual model in the augmented reality environment and viewing simulated views of the virtual model from the perspectives of objects in the virtual model, in accordance with some embodiments.

[0226] FIG. **5A28**, like FIG. **5A4**, illustrates a view of an augmented reality environment displayed on touch screen **112** of device **100**, including a live view of the physical space as captured by the camera of device **100**, virtual building model **5012**, virtual vehicle **5050**, and virtual person **5060**. In addition, reference box **5019** in FIG. **5A28** illustrates the position of device **100** relative to table **5004** and physical building model **5006**, from the perspective of user **5002** (e.g., as shown in FIGS. **5A1** and **5A2**).

[0227] FIGS. **5A29-5A31** illustrate a transition from FIG. **5A28**. In particular, FIGS. **5A29-5A31** illustrate a transition from a view of the augmented reality environment (e.g., shown in FIG. **5A28**) to a simulated view of the virtual model from the perspective of virtual vehicle **5050** in the virtual model.

[0228] FIG. **5A29** shows input **5052** detected at a location that corresponds to vehicle **5050** (e.g., a tap gesture on touch screen **112** of device **100**, or selection using a separate input device along with a focus indicator).

[0229] FIGS. **5A30-5A31** illustrate the transition from the view of the augmented reality environment to a simulated view of the virtual model from the perspective of vehicle **5050**, displayed in response to detecting input **5052**. In particular, FIG. **5A30** illustrates the view shown on device **100** during an animated transition from the view shown in FIG. **5A29** to the simulated perspective view from vehicle **5050** (e.g., from the perspective of a person, such as a driver or passenger, inside vehicle **5050**), and FIG. **5A31** illustrates the simulated perspective view from vehicle **5050**.

[0230] In some embodiments, the transition from the view of the augmented reality environment to the simulated perspective view includes an animated transition. Optionally, the transition includes an animation of flying from the position of viewing the augmented reality environment to the position of vehicle **5050** (e.g., the position of a person inside vehicle **5050**). For example, FIG. **5A30** shows a view of the virtual model from a position between the position of the user in FIG. **5A29** and the position of vehicle **5050** (e.g., partway through the animated transition), even though the user has not moved device **100** (e.g., the position of device **100** relative to physical building model **5006** as shown in reference box **5019** in FIG. **5A30** is the same as in FIG. **5A29**).

[0231] In some embodiments, portions of the field of view of device **100** (e.g., the cameras of device **100**) continue to be displayed during the animated transition to the perspective view from vehicle **5050**. For example, as shown in FIG. **5A30**, wallpaper **5007** and the edge of table **5004** are displayed during the animated transition to the simulated perspective view (e.g., as if viewed from the position corresponding to the view shown in FIG. **5A30**, between the position of the user in FIG. **5A29** and the position of vehicle **5050**). In some embodiments, the field of view of the cameras ceases to be displayed during the animated transition to the perspective view from vehicle **5050** (e.g., wallpaper **5007** and the edge of table **5004** are not displayed during the animated transition, and optionally, corresponding portions of the virtual model are displayed instead).

[0232] In FIG. **5A31**, the simulated perspective view from vehicle **5050**, also shows control **5054**, including directional arrows (up, down, left, and right) for controlling movement (e.g., direction of movement) of vehicle **5050** (e.g., the virtual object from which the simulated perspective view is displayed). In the example shown in FIG. **5A31**, up-arrow **5056** controls forward movement of vehicle **5050**. Thus, in some embodiments, the user can control the movement of a respective virtual object (e.g., vehicle **5050**), while the simulated view from the perspective of that virtual object is displayed. In some embodiments, the user cannot control the movement of the respective virtual object (e.g., virtual vehicle **5050** and/or virtual person **5060**) in the virtual model, while the view of the augmented reality environment is displayed. For example, in some embodiments, the user cannot control the movement of vehicle **5050** in the view of the augmented reality environment in FIG. **5A28**. In some embodiments, vehicle **5050** moves autonomously in the virtual model while the view of the augmented reality environment (e.g., FIG. **5A28**) is displayed.

[0233] FIGS. **5A32-5A33** illustrate a transition from FIG. **5A31**. In particular, FIGS. **5A32-5A33** illustrate user-controlled movement of vehicle **5050** in the virtual model. FIG. **5A32** shows input **5058** detected at a location that corresponds to up-arrow **5056** (shown in FIG. **5A31**) of control **5054**. In response to input **5058** on up-arrow **5056**, vehicle **5050** moves forward in the virtual model. Accordingly, FIG. **5A33** illustrates that an updated simulated perspective view of the virtual model, corresponding to forward movement of vehicle **5050** in the virtual model, is displayed. For example, in the updated simulated perspective view in FIG. **5A33**, less of virtual building model **5012** is visible, and person **5060** appears closer than in FIG. **5A32**.

[0234] FIGS. **5A34-5A35** illustrate a transition from FIG. **5A33**. In particular, FIGS. **5A34-5A35** illustrate a transition from the simulated view of the virtual model from the perspective of vehicle **5050** to a simulated view of the virtual model from the perspective of virtual person **5060**. FIG. **5A34** shows input **5062** detected at a location that corresponds to person **5060**. FIG. **5A35** illustrates a simulated view of the virtual model from the perspective of person **5060**, displayed in response to detecting input **5062**. In some embodiments, device **100** displays an animated transition between the simulated perspective view from vehicle **5050** and the simulated perspective view from person **5060** (e.g., as if the user were moving from the position of vehicle **5050** (e.g., within vehicle **5050**) to the position of person **5060**).

[0235] FIGS. **5A36-5A37** illustrate a transition from FIG. **5A35**. In particular, FIGS. **5A36-5A37** illustrate changing the view of the virtual model from the perspective of person **5060** (e.g., the selected virtual object) in response to movement of device **100** (e.g., in physical space).

[0236] FIG. **5A36** shows arrow **5064** indicating movement of device **100** toward the left, and rotation of device **100** about a z-axis (e.g., such that the right edge of device **100** moves closer to the user, and the left edge of device **100** moves further away from the user). FIG. **5A37** shows an updated simulated perspective view of the virtual model from the perspective of person **5060**, displayed in response to detecting the movement of device **100**. The updated simulated perspective view in FIG. **5A37** corresponds to the view of the virtual model as if person **5060** moved toward the left and turned his head slightly toward the right relative to his position in FIG. **5A36**. Reference box **5019** in FIG. **5A37** shows the new position of device **100** relative to physical building model **5006** after device **100** is moved as indicated by arrow **5064**.

[0237] In some embodiments, control **5054** (shown, for example, in FIG. **5A31**, but not shown in FIGS. **5A35**, **5A36**) is displayed while displaying the simulated view from the perspective of person **5060**, so that, while the simulated view from the perspective of person **5060** is displayed (e.g., FIG. **5A35**), the user can control movement of person **5060** in the virtual model using the arrows on control **5054**.

[0238] FIGS. **5A38-5A40** illustrate a transition from FIG. **5A37**. In particular, FIGS. **5A38-5A40** illustrate a transition from the simulated perspective view shown in FIG. **5A37** back to a view of the augmented reality environment.

[0239] FIG. **5A38** shows input **5066**. In the example shown in **5A38**, input **5066** is a pinch gesture (e.g., from a minimum zoom level for the simulated perspective view of the virtual model). In some embodiments, input **5066** is a gesture (e.g., a tap) on an "empty" location in the virtual model (e.g., a location from which a simulated perspective view is not available, such as a patch of grass). In some embodiments, input **5066** is a gesture (e.g., a tap) on an affordance for displaying, or redisplaying, the augmented reality environment (e.g., an icon, such as an "X", for exiting the simulated perspective view).

[0240] FIGS. **5A39-5A40** illustrate the transition from the simulated view of the virtual model from the perspective of person **5060** to a view of the augmented reality environment, displayed in response to detecting input **5066**. In particular, FIG. **5A39** illustrates the view shown on device **100** during an animated transition from the view shown in FIG. **5A38** to the view of the augmented reality environment, and FIG. **5A40** illustrates the view of the augmented reality environment. In some embodiments, the transition from the simulated perspective view to the view of the augmented reality environment includes an animated transition that optionally includes an animation of flying from the position of the virtual object (from which the simulated perspective view is shown) to the position of viewing the augmented reality environment.

[0241] Because device **100** is at a different position relative to physical building model **5006** in FIG. **5A38-5A40** than in FIGS. **5A28-5A30**, the view of the augmented reality as shown in FIG. **5A40** corresponds to the new position of device **100** and is different from that shown in FIG. **5A28**. Similarly, FIG. **5A39** shows a view of the virtual model from a position between the position of person **5060** in FIG. **5A38** and the position of the user in FIG. **5A40** (e.g., partway through the animated transition), even though the user has not moved device **100** (e.g., the position of device **100** relative to physical building model **5006** as shown in reference box **5019** is the same in each of FIGS. **5A38-5A40**).

[0242] Similar to the animated transition to the simulated perspective view, described above with reference to FIGS. **5A29-5A31**, in some embodiments, portions of the field of view of device **100** (e.g., the cameras of device **100**) are visible during the animated transition from the simulated perspective view to the view of the augmented reality environment. For example, as shown in FIG. **5A39**, wallpaper **5007** is displayed during the animated transition from the simulated perspective view (e.g., as if viewed from the position corresponding to the view shown in FIG. **5A39**, between the position of person **5060** and the position of the user in FIG. **5A40**). In some embodiments, the field of view of the cameras ceases to be displayed during the animated transition to the view of the augmented reality environment (e.g., wallpaper **5007** is not displayed during the animated transition, and optionally, corresponding portions of the virtual model are displayed instead).

[0243] FIGS. **5B 1-5B41** illustrate examples of systems and user interfaces for three-dimensional manipulation of virtual user interface objects, in accordance with some embodiments. The user interfaces in these figures are used to illustrate the processes described below, including the processes in FIGS. **6A-6D**, **7A-7C**, and **8A-8C**. For convenience of explanation, some of the embodiments will be discussed with reference to operations performed on a device with a touch-sensitive display system **112**. Similarly, analogous operations are, optionally, performed on a computer system (e.g., as shown in FIG. **5B2**) with a headset **5008** and a separate input device **5010** with a touch-sensitive surface in response to detecting the contacts on the touch-sensitive surface of the input device **5010** while displaying the user interfaces shown in the figures on the display of headset **5008**, along with a focus indicator.

[0244] FIGS. **5B 1-5B4** illustrate a context in which user interfaces described with regard to **5B5-5B41** are used.

[0245] FIG. **5B1** illustrates physical space **5200** in which a user **5202** and a table **5204** are located. Device **100** is held by user **5202** in the user's hand **5206**. A reference mat **5208** is located on table **5204**.

[0246] FIG. **5B2** shows a view of virtual-three dimensional space displayed on display **112** of device **100**. Reference mat **5208** is in the field of view of one or more cameras (e.g., optical sensors **164**) of device **100** (hereinafter referred to as "a camera," which indicates one or more cameras of device **100**). Display **112** shows a live view of the physical space **5200** as captured by the camera, including a displayed version **5208*b*** of physical reference mat **5208*a***. A virtual user interface object (virtual box **5210**) is displayed in virtual-three dimensional space displayed on display **112**. In some embodiments, virtual box **5210** is anchored to reference mat **5208*b***, such that a view of virtual box **5210** will change as the displayed view **5208*b*** of the reference mat changes in response to movement of reference mat **5208*a*** in physical space **5200** (e.g., as shown in FIGS. **5B2-5B3**). Similarly, a view of virtual box **5210** will change as a view of the displayed version **5208*b*** changes in response to movement of device **100** relative to reference mat **5208*a***.

[0247] In FIG. **5B3**, the reference mat **5208** has been rotated such that the longer side of reference mat **5208*a*** is adjacent to device **100** (whereas in FIG. **5B2** the shorter side of reference mat **5208*a*** was adjacent to device **100**). The rotation of the displayed version **5208*b*** of reference mat from FIGS. **5B2** to **5B3** occurs as a result of the rotation of the reference mat **5208*a*** in physical space **5200**.

[0248] In FIGS. **5B3-5B4**, the device **100** has moved closer to reference mat **5208*a***. As a result, the sizes of the displayed version **5208*b*** of the reference mat and virtual box **5210** have increased.

[0249] FIGS. **5B5-5B41** show a larger view of device **100** and, to provide a full view of the user interface displayed on display **112**, do not show the user's hands **5206**.

[0250] FIG. **5B5** illustrates a user interface, displayed on display **112**, for creating and adjusting virtual user interface objects. The user interface includes an avatar **5212**, a toggle **5214** (e.g., for toggling between a virtual reality display mode and an augmented reality display mode), a new object control **5216** (e.g., for adding a new object **5216** to the virtual three-dimensional space displayed by display **112**), a color selection palette **5218** that includes a number of controls that correspond to available colors (e.g., for selecting a color for a virtual object), and a deletion control **5220** (e.g., for removing a virtual user interface object from the virtual three-dimensional space). In FIG. **5B5**, toggle **5214** indicates that a current display mode is an augmented reality display mode (e.g., display **112** is displaying virtual box **5210** and a view of physical space **5200** as captured by a camera of device **100**). FIGS. **5B37-5B39** illustrate a virtual reality display mode. In FIGS. **5B37-5B39**, the appearance of toggle **5214** is altered to indicate that a virtual reality display mode is active (and that input at the toggle **5214** will cause a transition from the virtual reality display mode to the augmented reality display mode).

[0251] FIGS. **5**B**6**-**5**B**17** illustrate inputs that cause movement of virtual box **5210**.

[0252] In FIG. **5**B**6**, an input (e.g., a selection and movement input) by a contact **5222** (e.g., a contact with touch-sensitive display **112**) is detected on a first surface **5224** of virtual box **5210**. When a surface of virtual box **5210** is selected, movement of virtual box **5210** is limited to movement in a plane that is parallel to the selected surface. In response to detection of the contact **5222** that selects the first surface **5224** of virtual box **5210**, movement projections **5226** are shown extending from virtual box **5210** to indicate the plane of movement of virtual box **5210** (e.g., a plane of movement that is parallel to the selected first surface **5224** of virtual box **5210**).

[0253] In FIGS. **5**B**6**-**5**B**7**, the contact **5222** has moved along the surface of touch-sensitive display **112** in a direction indicated by arrow **5228**. In response to the movement of the contact **5222**, virtual box **5210** has moved within the plane indicated by the movement projections **5226** in the direction indicated by arrow **5228**. In FIGS. **5**B**7**-**5**B**8**, the contact **5222** has moved along the surface of touch-sensitive display **112** in a direction indicated by arrow **5230**. In response to the movement of the contact **5222**, virtual box **5210** has moved within the plane indicated by the movement projections **5226** in the direction indicated by arrow **5230**. In FIG. **5**B**9**, the contact **5222** has lifted off of touch-sensitive display **112**, and movement projections **5226** are no longer displayed.

[0254] In FIG. **5**B**10**, an input (e.g., a selection and movement input) by a contact **5232** is detected on a second surface **5234** of virtual box **5210**. In response to detection of the contact **5232** that selects the second surface **5234** of virtual box **5210**, movement projections **5236** are shown extending from virtual box **5210** to indicate the plane of movement of virtual box **5210** (e.g., a plane of movement that is parallel to the selected second surface **5234** of virtual box **5210**).

[0255] In FIGS. **5**B **10**-**5**B**11**, the contact **5232** has moved along the surface of touch-sensitive display **112** in a direction indicated by arrow **5238**. In response to the movement of the contact **5232**, virtual box **5210** has moved within the plane indicated by the movement projections **5236** in the direction indicated by arrow **5238**. As virtual box **5210** moves upward such that it is hovering over displayed reference mat **5208***b*, shadow **5240** of virtual box **5210** is displayed to indicate that the virtual box **5210** is hovering.

[0256] In FIGS. **5**B**11**-**5**B**12**, the contact **5232** has moved along the surface of touch-sensitive display **112** in a direction indicated by arrow **5242**. In response to the movement of the contact **5232**, virtual box **5210** has moved within the plane indicated by the movement projections **5236** in the direction indicated by arrow **5242**. In FIG. **5**B **13**, the contact **5232** has lifted off of touch-sensitive display **112** and movement projections **5236** are no longer displayed.

[0257] In FIG. **5**B**14**, an input (e.g., a selection and movement input) by a contact **5233** is detected on the first surface **5224** of virtual box **5210**. In response to detection of the contact **5233** that selects the first surface **5224** of virtual box **5210**, movement projections **5237** are shown extending from virtual box **5210** to indicate the plane of movement of virtual box **5210** (e.g., a plane of movement that is parallel to the selected first surface **5224** of virtual box **5210**).

[0258] In FIGS. **5**B**14**-**5**B**15**, the contact **5233** has moved along the surface of touch-sensitive display **112** in a direction indicated by arrow **5239**. In response to the movement of the contact **5233**, virtual box **5210** has moved within the plane indicated by the movement projections **5237** in the direction indicated by arrow **5238**. The movement of contact **5232** illustrated in FIGS. **5**B**10**-**5**B **11** is in the same direction as the movement of contact **5233** illustrated in FIGS. **5**B**14**-**5**B**15**. Because the movement of contact **5232** occurs while second surface **5234** of virtual box **5210** is selected, the plane of movement of virtual box **5210** in FIGS. **5**B**10**-**5**B **11** differs from the plane of movement of virtual box **5210** in FIGS. **5**B**14**-**5**B**15**, in which the movement of contact **5233** occurs while first surface **5224** of virtual box **5210** is selected. In this manner, a selection and movement input with the same direction of movement of the input causes different movement of the virtual box **5210** depending on the surface of the virtual box **5210** that is selected.

[0259] In FIGS. **5**B**15**-**5**B**16**, the contact **5233** has moved along the surface of touch-sensitive display **112** in a direction indicated by arrow **5243**. In response to the movement of the contact **5233**, virtual box **5210** has moved within the plane indicated by the movement projections **5237** in the direction indicated by arrow **5243**. In FIG. **5**B **17**, the contact **5233** has lifted off of touch-sensitive display **112** and movement projections **5237** are no longer displayed.

[0260] FIGS. **5**B**18**-**5**B**21** illustrate inputs that cause resizing of virtual box **5210**.

[0261] In FIG. **5**B**18**, an input (e.g., a resizing input) by contact **5244** is detected on the first surface **5224** of virtual box **5210**. In some embodiments, when a contact remains at a location that corresponds to a surface of a virtual object for a period of time that increases above a resizing time threshold, subsequent movement of the contact (and/or movement of the device **100**) causes resizing of the virtual object. In FIG. **5**B **19**, contact **5244** has remained in contact with the first surface **5224** of virtual box **5210** for a period of time that has increased above the resizing time threshold, and resizing projections **5246** are shown to indicate an axis (that is perpendicular to the selected first surface **5224**) along which virtual box **5210** will be resized in response to subsequent movement of the contact **5244**.

[0262] In FIGS. **5**B **19**-FIG. **5**B**20**, contact **5244** has moved along a path indicated by arrow **5248**. In response to the movement of the contact **5244**, the size of virtual box **5210** has increased along the axis indicated by the resizing projections **5246** in the direction indicated by arrow **5248**. In FIG. **5**B**21**, the contact **5244** has lifted off of touch-sensitive display **112**, and projections **5246** are no longer displayed.

[0263] FIGS. **5**B**22**-**5**B**27** illustrate placement of an object insertion cursor and placement of a virtual box using an insertion cursor.

[0264] In FIG. **5**B**22**, an input (e.g., a tap input) by contact **5250** is detected at a location that corresponds to the displayed version **5208***b* of physical reference mat **5208***a*. In response to detection of the contact **5250**, an insertion cursor **5252** is displayed at a location on display **112** that corresponds to the contact **5250**; in FIG. **5**B**23**, the contact **5250** has lifted off of touch-sensitive display **112** and insertion cursor **5252** is shown. In some embodiments, the insertion cursor **5252** ceases to be displayed after a predetermined period of time. In FIG. **5**B**24**, insertion cursor **5252** has ceased to be displayed and an input (e.g., a tap input) by a contact **5254** is detected at a location that is different from the location where insertion cursor **5252** had been shown (as indicated in FIG. **5**B**23**). In response to detection of the contact **5254**, a new insertion cursor **5256** is displayed at a location on display **112** that corresponds to the contact **5254**. In FIG. **5**B**25**, the contact **5254** has lifted off of touch-sensitive display **112** and insertion cursor **5256** is shown.

[0265] In FIG. **5**B**26**, insertion cursor **5256** has ceased to be displayed and an input (e.g., a tap input) by a contact **5258** is detected at a location that corresponds to the location where insertion cursor **5256** had been shown (as indicated in FIG. **5**B**25**). In response to detection of the contact **5258** at the location where an insertion cursor had been placed, a new virtual user interface object (virtual box **5260**) is displayed on display **112** at a location that corresponds to contact **5258**. In FIG. **5**B**27**, the contact **5258** has lifted off of touch-sensitive display **112**.

[0266] FIGS. **5**B**28**-**5**B**31** illustrate resizing of virtual box **5260** by movement of device **100**.

[0267] In FIG. **5**B**28**, an input (e.g., a resizing input) by contact **5262** with touch-sensitive display **112** is detected on a surface **5264** of virtual box **5260**. In FIG. **5**B**29**, contact **5262** has remained in contact with surface **5264** of virtual box **5260** for a period of time that has increased above the resizing time threshold, and resizing projections **5266** are shown to indicate an axis (that is perpendicular to the selected surface **5264**) along which virtual box **5260** will be resized in response to subsequent movement of the device **100**. In FIGS. **5**B**29**-**5**B**30**, device **100** moves along a path indicated by arrow **5268** while contact **5262** remains in contact with touch-sensitive display **112**. In response to the movement of the device **100**, the size of virtual box **5260** increases along the axis indicated by resizing projections **5266**, as shown in FIG. **5**B**30**. In FIG. **5**B**31**, the contact **5262** has lifted off of touch-sensitive display **112** and resizing projections **5266** are no longer displayed.

[0268] FIGS. **5**B**32**-**5**B**35** illustrate insertion of a new virtual object using new object control **5216**.

[0269] In FIG. **5**B**32**, an input (e.g., a tap input) by contact **5270** is detected at a location on the displayed version **5208***b* of physical reference mat **5208***a*. In response to detection of the contact **5270**, an insertion cursor **5272** is displayed at a location on display **112** that corresponds to the contact **5270**. In FIG. **5**B**33**, the contact **5270** has lifted off of touch-sensitive display **112** and insertion cursor **5272** is shown. In FIG. **5**B**34**, insertion cursor **5272** has ceased to be displayed and an input by contact **5274** with touch-sensitive display **112** (e.g., a tap input) is detected at a location that corresponds to new object control **5216**. In FIG. **5**B**35**, in response to the input at new object control **5216** (e.g., after placement of the insertion cursor **5272**), a new virtual user interface object (virtual box **5276**) is displayed on display **112** at a location that corresponds to the location where insertion cursor **5272** was shown.

[0270] FIGS. **5**B**36**-**5**B**37** illustrate a pinch-to-zoom input that causes a transition from an augmented reality display mode to a virtual reality display mode. FIGS. **5**B**39**-**5**B**40** illustrate an input at toggle **5214** for returning from the virtual reality display mode to the augmented reality display mode.

[0271] In FIG. **5**B**36**, contacts **5278** and **5280** with touch-sensitive display **112** are simultaneously detected. A pinch gesture is detected in which contacts **5278** and **5280** are moved simultaneously along the paths indicated by arrows **5282** and **5284**, respectively, as indicated in FIGS. **5**B**36**-**5**B**37**. In response to detecting the pinch gesture, the display of virtual boxes **5210**, **5260**, and **5276** is zoomed (e.g., zoomed out, such that the displayed sizes of the virtual boxes **5210**, **5260**, and **5276** become smaller). In some embodiments, the gesture for zooming causes a transition from an augmented reality display mode to a virtual reality display mode (e.g., because the zoomed view of the boxes no longer aligns with the field of view of the camera of device **100**). In some embodiments, in a virtual reality display mode, physical objects in the field of view of the camera of device **100** (e.g., reference mat **5208**) cease to be displayed, or a virtual (rendered) version of one or more of the physical objects are displayed.

[0272] In some embodiments, in a virtual reality display mode, virtual objects displayed by device **100** are locked to the frame of reference of the device **100**. In FIGS. **5**B**37**-**5**B**38**, the position of device **100** has changed. Because device **100** is in a virtual reality display mode, the positions of virtual boxes **5210**, **5260**, and **5276** have not changed in response to the changed position of device **100**.

[0273] In FIG. **5**B**39**, an input (e.g., a tap input) by contact **5286** is detected at a location that corresponds to toggle **5214**. In response to the input by contact **5286**, a transition from the virtual reality display mode to the augmented reality display mode occurs. FIG. **5**B**40** illustrates the user interface, displayed on display **112**, after the transition to the augmented reality display mode in response to the input by contact **5286**. The transition includes re-displaying the field of view of the camera of device **100** (e.g., re-displaying the displayed view **5208***b* of the reference mat). In some embodiments, the transition includes zooming (e.g., zooming in) the display of virtual boxes **5210**, **5260**, and **5276** (e.g., to realign the boxes with the field of view of the camera of device **100**).

[0274] In some embodiments, in an augmented reality display mode, virtual objects displayed by device **100** are locked to physical space **5200** and/or a physical object (e.g., reference mat **5208**) in physical space **5200**. In FIGS. **5**B**40**-**5**B**41**, the position of device **100** has changed. Because device **100** is in an augmented reality display mode, the virtual boxes **5210**, **5260**, and **5276** are locked to the reference mat **5208***a* and the positions of the virtual boxes on the display **112** are changed in response to the changed position of device **100**.

[0275] FIGS. **5**C**1**-**5**C**30** illustrate examples of systems and user interfaces for transitioning between viewing modes of a displayed simulated environment, in accordance with some embodiments. The user interfaces in these figures are used to illustrate the processes described below, including the processes in FIGS. **10**A-**10**E. For convenience of explanation, some of the embodiments will be discussed with reference to operations performed on a device with a touch-sensitive display system **112**. Similarly, analogous operations are, optionally, performed on a computer system (e.g., as shown in FIG. **5**A**2**) with a headset **5008** and a separate input device **5010** with a touch-sensitive surface in response to detecting the contacts on the touch-sensitive surface of the input device **5010** while displaying the user interfaces shown in the figures on the display of headset **5008**, along with a focus indicator.

[0276] FIGS. **5**C**1**-**5**C**2** illustrate a context in which user interfaces described with regard to **5**C**3**-**5**C**30** are used.

[0277] FIG. **5**C**1** illustrates physical space **5200** in which a user and a table **5204** are located. Device **100** is held by the user in the user's hand **5206**. A reference mat **5208** is located on table **5204**. A view of a simulated environment is displayed on display **112** of device **100**. Reference mat **5208** is in the field of view of one or more cameras (e.g., optical sensors **164**) of device **100** (hereinafter referred to as "a camera," which indicates one or more cameras of device **100**). Display **112** shows a live view of the physical space **5200** as captured by the camera, including a displayed version **5208***b* of physical reference mat **5208***a*. Two virtual user interface objects (first virtual box **5302** and second virtual box **5304**) are displayed in the simulated environment displayed on display **112**. In a first viewing mode (e.g., an augmented reality viewing mode), virtual boxes **5302** and **5304** are anchored to reference mat **5208***b*, such that a view of virtual boxes **5302** and **5304** will change as the displayed view **5208***b* of the reference mat changes in response to movement of reference mat **5208***a* in physical space **5200** (e.g., a fixed spatial relationship is maintained between virtual boxes **5302** and **5304** and the physical environment, including reference mat **5208***a*). Similarly, in the first viewing mode, a view of virtual boxes **5302** and **5304** changes in response to movement of device **100** relative to reference mat **5208***a*.

[0278] In FIG. **5C2**, the device **100** has moved closer to reference mat **5208***a*. As a result, the sizes of the displayed version **5208***b* of the reference mat and virtual boxes **5302** and **5304** have increased.

[0279] FIGS. **5C3**-**5C30** show a larger view of device **100** and, to provide a full view of the user interface displayed on display **112**, do not show the user's hands **5206**. Features of the user interface are described further above with regard to FIG. **5B5**.

[0280] FIGS. **5C4**-**5C6** illustrate an input gesture (including an upward swipe and a downward swipe) to move virtual box **5302** while the virtual box is displayed in an augmented reality viewing mode. Because the input gesture described with regard to FIGS. **5C4**-**5C6** is not a gesture that meets mode change criteria (e.g., for changing a viewing mode from an augmented reality viewing mode to a virtual reality viewing mode), a view of virtual boxes **5302** and **5304** changes in response to subsequent movement of device **100**, as illustrated in FIGS. **5C7**-**5C8** (e.g., such that a fixed spatial relationship is maintained between virtual boxes **5302** and **5304** and the physical environment, including reference mat **5208***a*).

[0281] Another example of gestures that do not meet mode change criteria are a resizing gesture (e.g., as described above with regard to FIGS. **5**B **18**-**5**B**21**).

[0282] In FIG. **5C4**, an input (e.g., a selection and movement input) by a contact **5306** is detected on a surface **5308** of virtual box **5302**. In response to detection of the contact **5306** that selects the surface **5308** of virtual box **5302**, movement projections **5310** are shown extending from virtual box **5302** to indicate the plane of movement of virtual box **5302** (e.g., a plane of movement that is parallel to the selected surface **5308** of virtual box **5302**).

[0283] In FIGS. **5C4**-**5C5**, the contact **5306** moves along the surface of touch-sensitive display **112** in a direction indicated by arrow **5312**. In response to the movement of the contact **5306**, virtual box **5302** has moved within the plane indicated by the movement projections **5310** in the direction indicated by arrow **5312**. As virtual box **5302** moves upward such that it is hovering over displayed reference mat **5208***b*, shadow **5314** of virtual box **5302** is displayed to indicate that the virtual box **5210** is hovering.

[0284] In FIGS. **5C5**-**5C6**, the contact **5306** moves along the surface of touch-sensitive display **112** in a direction indicated by arrow **5316**. In response to the movement of the contact **5306** virtual box **5302** has moved within the plane indicated by the movement projections **5310** in the direction indicated by arrow **5316**. In FIG. **5C7**, the contact **5306** has lifted off of touch-sensitive display **112** and movement projections **5310** are no longer displayed.

[0285] FIGS. **5C7**-**5C8** illustrate movement of the device **100** along a path indicated by arrow **5318**. As device **100** is moved, the positions of virtual boxes **5302** and **5304** as displayed be device **100** change on display **112** (e.g., such that a fixed spatial relationship is maintained between virtual boxes **5302** and **5304** and reference mat **5208***a* in the physical environment of device **100**).

[0286] FIGS. **5C9**-**5C10** illustrate an input gesture (a pinch gesture) that meets mode change criteria (e.g., causing a change in a viewing mode from an augmented reality viewing mode to a virtual reality viewing mode).

[0287] In FIG. **5C9**, contacts **5320** and **5324** are detected at touch-sensitive display **112**. In FIGS. **5C9**-**5C11**, contact **5320** moves along a path indicated by arrow **5322** and contact **5324** moves along a path indicated by arrow **5324**. In response to the simultaneous movement of contacts **5320** and **5324** that decreases the distance between contacts **5320** and **5324**, the displayed view of the simulated environment, including virtual boxes **5302** and **5304**, is zoomed out (e.g., such that the sizes of virtual boxes **5302** and **5304** increase on display **112**). As the zoom input is received, a transition from an augmented reality viewing mode to a virtual reality viewing mode occurs. A transition animation that occurs during the transition includes a gradual fading out of the displayed view of the physical environment. For example, the displayed view of table **5204** and displayed view **5208***b* of reference mat **5208***a*, as captured by one or more cameras of device **100**, gradually fade out (e.g., as shown at FIGS. **5C10**-**5C11**). The transition animation includes a gradual fade in of virtual grid lines of a virtual reference grid **5328** (e.g., as shown at FIGS. **5C11**-**5C12**). During the transition, an appearance of toggle **5214** (e.g., for toggling between a virtual reality display mode and an augmented reality display mode) is changed to indicate the current viewing mode (e.g., as shown at FIGS. **5C10**-**5C11**). After liftoff of contacts **5320** and **5324**, virtual boxes **5302** and **5304** in the simulated environment continue to move and decrease in size (e.g., the alteration of the simulated environment continues to have "momentum" that causes movement after the end of the input gesture).

[0288] In FIGS. **5C12**-**5C13**, device **100** is moved along a path indicated by arrow **5330**. Because the pinch-to-zoom input gesture described with regard to FIGS. **5C9**-**5C11** caused a change from an augmented reality viewing mode to a virtual reality viewing mode, the positions of virtual boxes **5302** and **5304** does not change in response to the movement of device **100** (e.g., in the virtual reality viewing mode, a fixed spatial relationship is not maintained between virtual boxes **5302** and **5304** and the physical environment).

[0289] In FIGS. **5C13**-**5C14**, device **100** is moved along a path indicated by arrow **5332**.

[0290] FIGS. **5C15**-**5C18** illustrate input for inserting a virtual box in the simulated environment displayed on device **100** while the simulated environment is displayed in a virtual reality viewing mode.

[0291] In FIG. **5C15**, an input (e.g., a tap input) by contact **5334** is detected on touch-sensitive display **112**. In response to detection of the contact **5334**, an insertion cursor **5336** is displayed at a location on display **112** that corresponds to the contact **5334**, as shown in FIG. **5C16**. In FIG. **5C17**, insertion cursor **5336** has ceased to be displayed and an input by contact **5338** (e.g., a tap input) is detected at a location that corresponds to new object control **5216**. In FIG. **5C 18**, in response to the input at new object control **5216** (e.g., after placement of the insertion cursor **5336**), a new virtual user interface object (virtual box **5340**) is displayed at a location that corresponds to the location where insertion cursor **5336** was shown.

[0292] FIGS. **5C19-5C20** illustrate input for manipulating a virtual user interface object in the simulated environment displayed on device **100** while the simulated environment is displayed in a virtual reality viewing mode.

[0293] In FIG. **5C19**, an input (e.g., a selection and movement input) by a contact **5342** is detected on a surface **5344** of virtual box **5340**. In response to detection of the contact **5342** that selects the surface **5344** of virtual box **5340**, movement projections **5348** are shown extending from virtual box **5340** to indicate the plane of movement of virtual box **5340** (e.g., a plane of movement that is parallel to the selected surface **5344** of virtual box **5340**). In FIGS. **5194-5C20**, the contact **5342** moves along the surface of touch-sensitive display **112** in a direction indicated by arrow **5346**. In response to the movement of the contact **5342**, virtual box **5340** has moved within the plane indicated by the movement projections **5348** in the direction indicated by arrow **5346**.

[0294] In FIG. **5C21**, the contact **5342** has lifted off of touch-sensitive display **112** and movement projections **5384** are no longer displayed.

[0295] FIGS. **5C22-5C23** illustrate an input gesture (e.g., a rotational gesture) to change the perspective of the simulated environment.

[0296] In FIG. **5C22**, a contact **5350** is detected at touch-sensitive display **112**. In FIGS. **5C22-5C23**, contact **5350** moves along a path indicated by arrow **5352**. As the contact **5350** moves, the simulated environment rotates. In FIG. **5C23**, the positions of virtual reference grid **5328** and virtual boxes **5302**, **5304**, and **5340** have rotated in response to the input by contact **5350**.

[0297] In FIGS. **5C24-5C25**, device **100** is moved along a path indicated by arrow **5354**. Because the simulated environment displayed on display **112** in FIGS. **5C24-5C25** is displayed in a virtual reality viewing mode, the positions of virtual boxes **5302** and **5304** on display **112** does not change in response to the movement of device **100**.

[0298] FIGS. **5C26-5C27** illustrate an input gesture (a depinch gesture) that cause a change in a viewing mode from a virtual reality viewing mode to an augmented reality viewing mode.

[0299] In FIG. **5C26**, contacts **5356** and **5360** are detected at touch-sensitive display **112**. In FIGS. **5C26-5C27**, contact **5356** moves along a path indicated by arrow **5358** and contact **5360** moves along a path indicated by arrow **5362**. In response to the simultaneous movement of contacts **5356** and **5360** that increases the distance between contacts **5356** and **5360**, the displayed view of the simulated environment, including virtual boxes **5302**, **5304**, and **5340**, is zoomed in (e.g., such that the sizes of virtual boxes **5302**, **5304**, and **5340** increase on display **112**). As the zoom input is received, a transition from a virtual reality viewing mode to an augmented reality viewing mode occurs. A transition animation that occurs during the transition includes a gradual fading out of the virtual reference grid **5328** (e.g., as shown at FIGS. **5C26-5C27**). The transition animation includes a gradual fading in of a view of the physical environment. For example, table **5204** and reference mat **5208***a*, as captured by one or more cameras of device **100**, gradually become visible on display **112** (e.g., as shown at FIGS. **5C28-5C30**). During the transition, an appearance of toggle **5214** is changed to indicate the current viewing mode (e.g., as shown at FIGS. **5C27-5C28**). After liftoff of contacts **5356** and **5360**, virtual boxes **5302**, **5304**, and **5340** in the simulated environment continue to increase in size, move, and rotate (e.g., until the original spatial between virtual boxes **5302** and **5304** and reference mat **5208***a* is restored), as shown in FIG. **5C28-5C30**.

[0300] In some embodiments, the virtual box **5340** that was added while a virtual reality viewing mode was active is visible in the alternate reality viewing mode, as shown in FIG. **5C30**.

[0301] In some embodiments, a change in a viewing mode from a virtual reality viewing mode to an augmented reality viewing mode occurs in response to an input (e.g., a tap input) by a contact at a location corresponding to toggle **5214**. For example, in response to a tap input detected at a location corresponding to toggle **5214**, a transition from displaying a virtual reality viewing mode (e.g., as shown in FIG. **5C26**) to an augmented reality viewing mode (e.g., as shown in FIG. **5C30**) occurs. In some embodiments, during the transition, a transition animation that is the same as or similar to the animation illustrated at **5C26-5C30** is displayed.

[0302] FIGS. **5D1-5D14** illustrate examples of systems and user interfaces for updating an indication of a viewing perspective of a second computer system in a simulated environment displayed by a first computer system, in accordance with some embodiments. The user interfaces in these figures are used to illustrate the processes described below, including the processes in FIGS. **11A-11C**. For convenience of explanation, some of the embodiments will be discussed with reference to operations performed on a device with a touch-sensitive display system **112**. Similarly, analogous operations are, optionally, performed on a computer system (e.g., as shown in FIG. **5A2**) with a headset **5008** and a separate input device **5010** with a touch-sensitive surface in response to detecting the contacts on the touch-sensitive surface of the input device **5010** while displaying the user interfaces shown in the figures on the display of headset **5008**, along with a focus indicator.

[0303] FIGS. **5D1-5D2** illustrate a context in which user interfaces described with regard to **5D3-5D14** are used.

[0304] FIG. **5D1** illustrates physical space **5400** in which two users **5402** and **5408** and a table **5414** are located. A first device **5406** (e.g., a device **100**) is held by first user **5402** in the first user's hand **5404**. A second device **5412** (e.g., a device **100**) is held by second user **5408** in the second user's hand **5410**. A reference mat **5416***a* is located on table **5414**.

[0305] FIG. **5D2** shows a view of virtual-three dimensional space displayed on display **5148** (e.g., a display **112**) of device **5406**. Reference mat **5416** is in the field of view of one or more cameras (e.g., optical sensors **164**) of device

5406 (hereinafter referred to as "a camera," which indicates one or more cameras of device **5406**). Display **5148** shows a live view of the physical space **5400** as captured by the camera, including a displayed version **5416***b* of physical reference mat **5416***a*. A virtual user interface object (virtual box **5420**) in a simulated environment displayed on display **5418**. In some embodiments, virtual box **5420** is anchored to reference mat **5416***b*, such that a view of virtual box **5420** will change as a view of the displayed version **5416***b* of the reference mat changes in response to movement of device **100** relative to reference mat **5416***a*. Features of the user interface are described further above with regard to FIG. 5B5.

[0306] FIGS. **5**D**3**-**5**D**11** include a sub-figure "a" that illustrates the orientation in physical space **5400** of first device **5406** and second device **5412** relative to table **5414** (e.g., as shown at FIG. **5**D**3***a*), a sub-figure "b" that illustrates a user interface of the first device **5412** (e.g., as shown at FIG. **5**D**3***b*), and a sub-figure "c" that illustrates a user interface of the second device **5412** (e.g., as shown at FIG. **5**D**3***c*). To provide a full view of the user interfaces, the user interfaces in FIGS. **5**D**3**-**5**D**11** do not show the hands that are holding the devices. Also, for clarity, the user interfaces in FIGS. **5**D**3**-**5**D **11** do not show the bodies of users **5402** and **5408**. It is to be understood that any part of the body of user **5408** that is in the field of view of a camera of device **5406** will typically be visible in a user interface displayed on device **5406** (although the view of the user's body may be blocked by a virtual user interface object or other user interface element). For example, in FIG. **5**D**2**, the body and hand of user **5408** is visible in the user interface displayed by device **5409**.

[0307] FIGS. **5**D**3**-**5**D**4** illustrate movement of second device **5412**.

[0308] In FIG. **5**D**3***a*, second device **5412** is displayed at a first position relative to table **5414** (e.g., a position that is adjacent to the far left side of the table).

[0309] In FIG. **5**D**3***b*, the user interface of device **5406** includes an avatar key **5422** that includes a key avatar **5424** that corresponds to device **5406** and a key avatar **5426** that corresponds to device **5412**. The avatar key **5422** includes a name ("Me") that corresponds to key avatar **5424** and a name ("Zoe") that corresponds to key avatar **5426**. The key avatars shown in the avatar key provide a guide to the avatars (e.g., avatar **5428**) that are shown in the visible environment, for example, to help the user of device **5406** to understand that avatar **5428** in the simulated environment corresponds to the device **5412** of user "Zoe" (e.g., because avatar **5428** in the simulated environment is a cat icon that matches key avatar **5426**).

[0310] The simulated environment displayed on the user interface of device **5406** includes virtual box **5420** and a displayed view **5416***b* of physical reference mat **5416***a*, shown from the perspective of device **5406**. A viewing perspective of device **5412** is indicated by viewing perspective indicator **5432**. Viewing perspective indicator **5432** is shown emanating from avatar **5428**. In the simulated environment, a representation **5430** of device **5412** (e.g., a view of device **5412** as captured by a camera of device **5406** and/or a rendered version of device **5412**) is shown.

[0311] In FIG. **5**D**3***c*, the user interface of device **5412** includes an avatar key **5434** that includes a key avatar **5436** that corresponds to device **5412** and a key avatar **5468** that corresponds to device **5406**. The avatar key **5434** includes a name ("Me") that corresponds to key avatar **5436** and a name ("Gabe") that corresponds to key avatar **5438**. The key avatars shown in the avatar key provide a guide to the avatars (e.g., avatar **5440**) that are shown in the visible environment, for example, to help the user of device **5412** to understand that avatar **5440** in the simulated environment corresponds to the device **5406** of user "Gabe" (e.g., because avatar **5440** in the simulated environment is a smiley face icon that matches key avatar **5438**).

[0312] In FIG. **5**D**4***a*, second device **5412** has moved from the first position relative to table **5414** shown in FIG. **5**D**3***a* to a second position relative to table **5414** (e.g., a position that is adjacent to the near left side of the table). In FIG. **5**D**4***b*, the user interface of device **5406** shows device **5412** (indicated by avatar **5428** and representation **5430** of the device) at a position that has changed from FIG. **5**D**3***b*. A change in the viewing perspective of device **5412** is indicated by the different angles of viewing perspective indicator **5432** from FIG. **5**D**3***b* to FIG. **5**D**4***b*. The movement of device **5412** is also illustrated by the changed view displayed reference mat **5416***b*, and virtual box **5420** from in the user interface of device **5412** in FIGS. **5**D**3***c* to **5**D**4***c*.

[0313] FIGS. **5**D**5**-**5**D**7** illustrate selection and movement of virtual box **5420** by device **5412**.

[0314] In FIG. **5**D**5***c*, an input (e.g., a selection and movement input) by a contact **5446** is detected on a touch screen display of second device **5412** at a location that corresponds to a surface of virtual box **5420**. In response to detection of the contact **5446** that selects the surface of virtual box **5420**, movement projections **5448** are shown extending from virtual box **5420** to indicate the plane of movement of virtual box **5420** (e.g., a plane of movement that is parallel to the selected surface of virtual box **5420**).

[0315] In FIG. **5**D**5***b*, an interaction indicator **5452** is shown to indicate to the user of first device **5406** that second device **5412** is interacting with virtual box **5420**. Interaction indicator **5452** extends from a location that corresponds to avatar **5428** to a location that corresponds to virtual box **5420**. A control handle **5454** is shown at a location where indication indicator **5452** meets virtual box **5420**.

[0316] In FIGS. **5**D**5***c*-**5**D**6***c*, the contact **5446** moves along the touch-sensitive display of device **5412** in a direction indicated by arrow **5450**. In response to the movement of the contact **5446**, virtual box **5420** has moved within the plane indicated by the movement projections **5448** in the direction indicated by arrow **5450**.

[0317] In FIGS. **5**D**5***b*-**5**D**6***b*, the user interface of first device **5406** shows movement of interaction indicator **5452** and control handle **5454** (e.g., to maintain the connection between interaction indicator **5452** and virtual box **5420**) as virtual box **5420** is moved by the movement input detected at second device **5412**.

[0318] In FIG. **5**D**7***c*, the contact **5446** has lifted off of the touch-sensitive display of device **5412** and movement projections **5448** are no longer displayed. In FIG. **5**D**7***b*, interaction indicator **5452** and control handle **5454** are no longer displayed (because device **5412** is not interacting with virtual box **5420**).

[0319] FIGS. **5**D**8**-**5**D **11** illustrate resizing of virtual box **5420** by device **5412**.

[0320] In FIG. **5**D**8***c*, an input (e.g., a resizing input) by a contact **5456** is detected on a touch screen display of second device **5412** at a location that corresponds to a surface of virtual box **5420**.

[0321] In FIG. **5**D**8***b*, an interaction indicator **5462** and control handle **5464** are shown on the user interface of first device **5406** to indicate that second device **5412** is interacting with virtual box **5420**.

[0322] In FIG. **5**D**9***c*, after contact **5456** has remained at a location that corresponds to a surface of virtual box **5420** for a period of time that increases above a resizing time threshold, resizing projections **5458** are shown to indicate an axis (that is perpendicular to the selected surface of virtual box **5420**) along which virtual box **5420** will be resized in response to subsequent movement of the contact **5456**.

[0323] FIGS. **5**D**9***a*-**5**D**10***a* show second device **5412** moving upward (while contact **5456** is in contact with the touch screen display of second device **5412**) to resize virtual box **5420**. In response to the movement of the device **5412**, the size of virtual box **5420** has increased along the axis indicated by the resizing projections **5458** in the direction that second device **5412** moved.

[0324] In FIG. **5**D**11***c*, the contact **5456** has lifted off of touch-sensitive display **112**, and projections **5458** are no longer displayed.

[0325] As illustrated in FIGS. **5**D**12**-**5**D**14**, users that are not in the same physical space can view and collaboratively manipulate objects in a simulated environment. For example, a user in a first physical space views a virtual user interface object (e.g., virtual box **5420**) that is anchored to a displayed version of a first physical reference mat (e.g., **5416***a*), and a different user at a remote location views the same virtual user interface object anchored to a displayed version of a second physical reference mat (e.g., **5476***a*).

[0326] FIG. **5**D**12***a* illustrates a first physical space **5400** in which two users **5402** and **5408** and a table **5414** are located, as was shown in FIG. **5**D**1**. FIG. **5**D**12***b* shows a second physical space **5470**, separate from the first physical space **5400**, in which a third user **5472** and a table **5474** are located. A third device **5478** (e.g., a device **100**) is held by third user **5472**. A reference mat **5476***a* is located on table **5474**. The device **5478** of third user **5472** displays the same simulated environment that is displayed by device **5412** of first user **5408** and device **5404** of second user **5402**.

[0327] FIG. **5**D**13***a* shows first physical space **5400**, as described with regard to FIG. **5**D**12***a*, and FIG. **5**D**13***b* shows second physical space **5470**, as described with regard to FIG. **5**D**12***b*.

[0328] In FIG. **5**D**13***c*, the user interface of first device **5406** includes an avatar key **5422** that includes a key avatar **5480** (for "Stan") that corresponds to third device **5478**. Avatar **5482**, which corresponds to third device **5478** (as indicated by key avatar **5480**), is shown in the simulated environment displayed by **5406** at a location relative to displayed version **5416***b* of physical reference mat **5416***a* that corresponds to a position of device **5478** relative to physical reference mat **5476***a*. A viewing perspective of device **5478** is indicated by viewing perspective indicator **5486**. A representation **5484** of device **5478** (e.g., a rendered version of the device) is shown in the simulated environment displayed by device **5406**.

[0329] As shown in FIG. **5**D**13***d*, the user interface of second device **5412** also displays an avatar **5482** that corresponds to third device **5478**, a viewing perspective indicator **5486** to indicate the viewing perspective of device **5478**, and a representation **5484** of device **5478**.

[0330] FIG. **5**D**14***a* shows first physical space **5400**, as described with regard to FIG. **5**D**12***a*, and FIG. **5**D**14***b* shows second physical space **5470**, as described with regard to FIG. **5**D**12***b*.

[0331] FIG. **5**D**14***c* shows the user interface of the third device **5478**. In FIG. **5**D**14***c*, virtual box **5420** is shown anchored to a displayed view **5476***b* of physical reference mat **5476***a*. Avatar **5488**, which corresponds to first device **5406**, is shown in the simulated environment displayed by third device **5478** at a location relative to displayed version **5476***b* of physical reference mat **5476***a* that corresponds to a position of first device **5406** relative to physical reference mat **5416***a*. A viewing perspective of first device **5406** is indicated by viewing perspective indicator **5490**. A representation **5490** of first device **5406** (e.g., a rendered version of the first device) is shown in the simulated environment displayed by third device **5476**. Avatar **5494**, which corresponds to second device **5412**, is shown in the simulated environment at a location relative to displayed version **5476***b* of physical reference mat **5476***a* that corresponds to a position of second device **5412** relative to physical reference mat **5416***a*. A viewing perspective of second device **5412** is indicated by viewing perspective indicator **5498**. A representation **5496** of second device **5412** (e.g., a rendered version of the second device) is shown in the simulated environment displayed by third device **5476**.

[0332] FIGS. **5**E**1**-**5**E**32** illustrate examples of systems and user interfaces for placement of an insertion cursor, in accordance with some embodiments. The user interfaces in these figures are used to illustrate the processes described below, including the processes in FIGS. **12**A-**12**D. For convenience of explanation, some of the embodiments will be discussed with reference to operations performed on a device with a touch-sensitive display system **112**. Similarly, analogous operations are, optionally, performed on a computer system (e.g., as shown in FIG. **5**A**2**) with a headset **5008** and a separate input device **5010** with a touch-sensitive surface in response to detecting the contacts on the touch-sensitive surface of the input device **5010** while displaying the user interfaces shown in the figures on the display of headset **5008**, along with a focus indicator.

[0333] FIGS. **5**E**1**-**5**E**3** illustrate a context in which user interfaces described with regard to **5**E**4**-**5**E**32** are used.

[0334] FIG. **5**E**1** illustrates physical space **5200** in which a user **5202** and a table **5204** are located. Device **100** is held by user **5202** in the user's hand **5206**. A reference mat **5208** is located on table **5204**.

[0335] FIG. **5**E**2** shows a view of virtual-three dimensional space displayed on display **112** of device **100**. Reference mat **5208** is in the field of view of one or more cameras (e.g., optical sensors **164**) of device **100** (hereinafter referred to as "a camera," which indicates one or more cameras of device **100**). Display **112** shows a live view of the physical space **5200** as captured by the camera, including a displayed version **5208***b* of physical reference mat **5208***a*.

[0336] In FIG. **5**E**3**, the device **100** has moved closer to reference mat **5208***a*. As a result, the size of the displayed version **5208***b* of the reference mat has increased.

[0337] FIGS. **5**E**4**-**5**E**32** show a larger view of device **100** and, to provide a full view of the user interface displayed on display **112**, do not show the user's hands **5206**.

[0338] FIGS. **5**E**5**-**5**E**6** illustrate an input that causes placement of an insertion cursor at a first location.

[0339] In FIG. **5**E**5**, an input (e.g., a tap input) by contact **5502** is detected at a first location on displayed version **5208***b* of physical reference mat **5208***a*. In FIG. **5**E**6**, the contact **5502** has lifted off of touch-sensitive display **112** and insertion cursor **5504** is shown at a location where contact **5502** was detected.

[0340] FIGS. **5**E**7**-**5**E**8** illustrate an input that causes placement of an insertion cursor at a second location. In FIG. **5**E**7**, an input (e.g., a tap input) by a contact **5506** is detected at a location that is different from the location where insertion cursor **5504** is displayed. In FIG. **5**E**8**, the contact **5506** has lifted off of touch-sensitive display **112** and insertion cursor **5508** is shown at a location where contact **5506** was detected.

[0341] FIGS. **5**E**9**-**5**E**10** illustrate an input that causes insertion of a virtual user interface object. In FIG. **5**E**9**, an input (e.g., a tap input) by a contact **5510** is detected at a location that corresponds to the location of insertion cursor **5508**. In response to detection of the contact **5510** at the location where an insertion cursor had been placed, a virtual user interface object (first virtual box **5512**) is displayed on display **112** at a location that corresponds to contact **5510** and the insertion cursor **5508** is moved from its previous position on displayed view **5208***b* of reference mat **5208***a* to surface **5514** of first virtual box **5512**. In some embodiments, a shadow **5522** is displayed (e.g., a simulated light causes a shadow to be cast by the first virtual box **5512**).

[0342] FIGS. **5**E**11**-**5**E**12** illustrate an input detected at a surface of a virtual user interface object (first virtual box **5512**) that causes insertion of an additional virtual user interface object. In FIG. **5**E**11**, an input (e.g., a tap input) by a contact **5516** is detected at a location on surface **5514** of first virtual box **5512** while insertion cursor **5516** is located on surface **5514**. In response to detection of the input by contact **5516**, a new virtual user interface object (second virtual box **5518**) is displayed on display **112** at a location that corresponds to contact **5510** and the insertion cursor **5508** is moved from surface **5514** of first virtual box **5512** to surface **5520** of the second virtual box **5518**. A length of shadow **5522** is increased (such that the shadow appears to be cast by first virtual box **5512** and newly added second virtual box **5518**).

[0343] FIGS. **5**E**12**-**5**E**13** illustrate rotation of physical reference mat **5208**. For example, a user **5202** manually changes the position and/or orientation of reference mat **5208**. As physical reference mat **5208***a* rotates, virtual boxes **5512** and **5518** and shadow **5522** rotate (because the virtual boxes **5512** and **5518** are anchored to displayed view **5208***b* of physical reference mat **5208***a*).

[0344] FIGS. **5**E**14**-**5**E**16** illustrate movement of device **100**. For example, a user **5202** holding device **100** changes the position and/or orientation of the device. In FIGS. **5**E**14**-**5**E**15**, as device **100** moves, virtual boxes **5512** and **5518** and shadow **5522** move (because the virtual boxes **5512** and **5518** are anchored to displayed view **5208***b* of physical reference mat **5208***a*). Similarly, in FIGS. **5**E**15**-**5**E**16**, as device **100** moves, virtual boxes **5512** and **5518** and shadow **5522** move

[0345] FIGS. **5**E**17**-**5**E**18** illustrate input that changes the location of insertion cursor **5526** on virtual box **5518**. In FIG. **5**E**17**, an input (e.g., a tap input) by a contact **5524** is detected at surface **5528** of virtual box **5518** while insertion cursor **5526** is located on surface **5520** of virtual box **55182**. In FIG. **5**E**18**, the contact **5524** has lifted off of touch-sensitive display **112** and insertion cursor **5508** is moved from surface **5520** of virtual box **5518** to surface **5528** of virtual box **5518**.

[0346] FIGS. **5**E**19**-**5**E**20** illustrate an input detected at a surface of second virtual box **5518** that causes insertion of a third virtual box **5532**. In FIG. **5**E**19**, an input (e.g., a tap input) by a contact **5530** is detected at a location on surface **5528** of second virtual box **5518** while insertion cursor **5526** is located on surface **5268**. In response to detection of the input by contact **5530**, a third virtual box **5532** is displayed on display **112** at a location that corresponds to contact **5530** and the insertion cursor **5526** is moved from surface **5528** of second virtual box **5518** to surface **5526** of the third virtual box **5532**. A shape of shadow **5522** is changed (such that the shadow appears to be cast by first virtual box **5512**, second virtual box **5518**, and newly added third virtual box **5532**).

[0347] FIGS. **5**E**21**-**5**E**22** illustrate input that changes the location of insertion cursor **5538** on virtual box **5532**. In FIG. **5**E**21**, an input (e.g., a tap input) by a contact **5536** is detected at surface **5538** of virtual box **5532** while insertion cursor **5526** is located on surface **5534** of virtual box **5532**. In FIG. **5**E**22**, the contact **5536** has lifted off of touch-sensitive display **112** and insertion cursor **5526** is moved from surface **5534** of virtual box **5518** to surface **5538** of virtual box **5532**.

[0348] FIGS. **5**E**23**-**5**E**24** illustrate insertion of a new virtual user interface object using new object control **5216**.

[0349] In FIG. **5**E**23**, while insertion cursor **5526** is at surface **5538** of virtual box **5532**, an input (e.g., a tap input) by contact **5542** is detected at a location on display **112** that corresponds to new object control **5216**. In FIG. **5**E**24**, in response to the input at the location that corresponds to new object control **5216**, a fourth virtual box **5546** is displayed on display **112** at a location that corresponds to the location where insertion cursor **5526** was shown and insertion cursor **5526** is moved from surface **5538** of virtual box **5532** to surface **5548** of fourth virtual box **5546**.

[0350] FIGS. **5**E**25**-**5**E**27** illustrate input that causes movement of fourth virtual box **5546**.

[0351] In FIG. **5**E**25**, an input (e.g., a selection and movement input) by a contact **5550** is detected on the surface **5556** of fourth virtual box **5546**. In response to detection of the contact **5550** that selects the surface **5556** of fourth virtual box **5546**, movement projections **5552** are shown extending from virtual box **5546** to indicate the plane of movement of fourth virtual box **5546** (e.g., a plane of movement that is parallel to the selected surface **5556** of virtual box **5546**).

[0352] In FIGS. **5**E**25**-**5**E**26**, the contact **5550** has moved along the surface of touch-sensitive display **112** in a direction indicated by arrow **5554**. In response to the movement of the contact **5550**, fourth virtual box **5546** has moved within the plane indicated by the movement projections **5552** in the direction indicated by arrow **5554**. In FIG. **5**E**27**, the contact **5550** has lifted off of touch-sensitive display **112** and movement projections **5552** are no longer displayed.

[0353] FIGS. **5**E**28**-**5**E**32** illustrate input that causes resizing of fourth virtual box **5546**.

[0354] In FIG. **5**E**28**, an input (e.g., a resizing input) by a contact **5258** is detected on touch screen display **112** at a location that corresponds to surface **5556** of fourth virtual box **5546**.

[0355] In FIG. **5**E**29**, after contact **5255** has remained at the location that corresponds to surface **5556** of fourth virtual box **5546** for a period of time that increases above a resizing time threshold, resizing projections **5560** are shown to indicate an axis (that is perpendicular to the selected surface of virtual box **5546**) along which virtual box **5546** will be resized in response to subsequent movement of the contact **5558**.

[0356] In FIGS. **5**E**30**-**5**E**31**, contact **5558** moves across touch screen display **112** along a path indicated by arrow **5562**. In response to the movement of the contact **5558**, the size of virtual box **5548** has increased along the axis indicated by the resizing projections **5560** in the direction of movement of contact **5558**.

[0357] In FIG. **5**E**32**, the contact **5558** has lifted off of touch-sensitive display **112**, and projections **5560** are no longer displayed.

[0358] FIGS. **5**F**1**-**5**F**17** illustrate examples of systems and user interfaces for displaying an augmented reality environment in a stabilized mode of operation, in accordance with some embodiments. The user interfaces in these figures are used to illustrate the processes described below, including the processes in FIGS. **13**A-**13**E. For convenience of explanation, some of the embodiments will be discussed with reference to operations performed on a device with a touch-sensitive display system **112**. Similarly, analogous operations are, optionally, performed on a computer system (e.g., as shown in FIG. **5**A**2**) with a headset **5008** and a separate input device **5010** with a touch-sensitive surface in response to detecting the contacts on the touch-sensitive surface of the input device **5010** while displaying the user interfaces shown in the figures on the display of headset **5008**, along with a focus indicator.

[0359] FIGS. **5**F**1**-**5**F**2** illustrate a context in which user interfaces described with regard to **5**F**3**-**5**F**17** are used.

[0360] FIG. **5**F**1** illustrates physical space **5200** in which a user **5202** and a table **5204** are located. Device **100** is held by user **5202** in the user's hand **5206**. An object (physical box **5602**) is located on table **5204**.

[0361] FIG. **5**F**2** shows an augmented reality environment displayed by display **112** of device **100**. Table **5204** (referenced as **5204***a* when referring to the table in physical space) and physical box **5602** are in the field of view of one or more cameras (e.g., optical sensors **164**) of device **100** (hereinafter referred to as "a camera," which indicates one or more cameras of device **100**). Display **112** shows a live view of the physical space **5200** as captured by the camera, including a displayed version **5204***b* of table **5204***a* and a rendered virtual box **5604** displayed at a location in the simulated environment that corresponds to physical box **5602** as detected by the camera of device **100**.

[0362] FIGS. **5**F**3**-**5**F **17** include a sub-figure "a" that illustrates the orientation in physical space **5200** of device **100** relative to table **5204***a* and physical box **5602** (e.g., as shown at FIG. **5**F**3***a*), and a sub-figure "b" that illustrates a user interface of device **100** (e.g., as shown at FIG. **5**F**3***b*). Also, for clarity, FIGS. **5**F**3**-**5**F **18** show a larger view of device **100** and, to provide a full view of the user interface displayed on display **112**, do not show the user's hands **5206**.

[0363] FIGS. **5**F**3***a*-**5**F**4***a* illustrate movement of device **100** relative to table **5204***a* and physical box **5602** that occurs while the augmented reality environment is displayed by device **100** (as shown in FIGS. **5**F**3***b*-**5**F**4***b*) in a non-stabilized mode of operation. When device **100** is at a first position relative to table **5204***a*, as shown in FIG. **5**F**3***a*, the rendered version **5604** of physical object **5602** is fully visible in the user interface shown in FIG. **5**F**3***b*. In FIG. **5**F**4***a*, device **100** has been moved to a second position relative to table **5204***a* and the rendered version **5604** of physical object **5602** is only partially visible in the user interface shown in FIG. **5**F**4***b*. In the non-stabilized mode of operation, as device **100** moves, the view of virtual box **5604** changes so as to maintain a fixed spatial relationship between virtual box **5604** and physical box **5602** and the displayed representation of the field of view of the camera of device **100** (e.g., including displayed table **5204***b*) is updated based on the movement of the device.

[0364] FIGS. **5**F**5**-**5**F**8** illustrate an input (e.g., a depinch-to-zoom-out input) that causes the device to display an augmented reality environment in a stabilized mode of operation.

[0365] In FIG. **5**F**5**, device **100** is at the first position relative to table **5204**. In FIG. **5**F**6**, contacts **5606** and **5608** are detected at touch-sensitive display **112** (as shown at FIG. **5**F**6***b*). As shown in FIGS. **5**F**6***b*-**5**F**7***b*, contact **5606** moves along a path indicated by arrow **5610** and contact **5608** moves along a path indicated by arrow **5612**. In response to the simultaneous movement of contacts **5606** and **5608** that increases the distance between contacts **5606** and **5608**, the displayed augmented reality environment, including virtual box **5604**, is zoomed in (e.g., such that the sizes of virtual box **5604** increases on display **112**). The virtual box **5604** is re-rendered in response to the zoom input (e.g., the larger virtual box **5604** of FIG. **5**F**8***b* has the same resolution as the smaller virtual box **5604** of FIG. **5**F**5***b*). In some embodiments, the field of view of camera of device **100** displayed on display **112** (e.g., the displayed view **5204***b* of table **5204***a*) is not changed in response to the zoom input (as shown in FIGS. **5**F**5***b*-**5**F**8***b*). As the zoom input is received, a transition from a non-stabilized mode of operation to a stabilized mode of operation occurs. In FIG. **5**F**8**, the contacts **5606** and **5608** have lifted off of touchscreen display **112**.

[0366] In some embodiments, while a device is displaying an augmented reality environment in a stabilized mode of operation, as movement of the device causes a virtual user interface object to extend beyond the field of view of the device camera, a portion of the virtual user interface object ceases to be displayed. FIGS. **5**F**8**-**5**F**9** illustrate a movement of device **100**, while device **100** is in a stabilized mode of operation, that causes a portion of the virtual user interface object **5304** to cease to be displayed. FIGS. **5**F**8***a*-**5**F**9***a* illustrate movement of device **100** relative to table **5204***a* and physical box **5602** that occurs while the augmented reality environment is displayed by device **100** (as shown in FIGS. **5**F**8***b*-**5**F**9***b*) in a stabilized mode of operation. When device **100** is at a first position relative to table **5204***a*, as shown in FIG. **5**F**8***a*, the zoomed, rendered version **5604** of physical object **5602** is fully visible in the user interface shown in FIG. **5**F**8***b*. In FIG. **5**F**9***a*, device **100** has been moved to a second position relative to table **5204***a* such that updating the view of virtual box **5604** to maintain a fixed spatial relationship between virtual box **5604** and physical box **5602** causes the virtual box **5604** to extend beyond the field of the camera of device **100**. As a result, a portion of virtual box **5064** that extends beyond the field of the camera of device **100** is not displayed.

[0367] In some embodiments, while a device is displaying an augmented reality environment in a stabilized mode of operation and movement of the device causes a virtual user interface object to extend beyond the field of view of the device camera, the augmented reality environment is zoomed out such that the virtual user interface object is fully displayed. For example, from FIG. **5**F**9***b* to FIG. **5**F **10***b*, the displayed augmented reality environment, including virtual box **5604** has zoomed out such that virtual box **5604** is fully displayed.

[0368] In some embodiments, in the stabilized mode of operation, when updating the view of virtual box **5604** to maintain a fixed spatial relationship between virtual box **5604** and physical box **5602** causes the virtual box **5604** to extend beyond the field of the camera of device **100**, the virtual box **5604** is displayed with a placeholder image at a location that corresponds to the portion of virtual box **5064** that extends beyond the field of view of the device camera. In FIG. **5**F **10***b*, the rendered version **5604** of physical object **5602** is displayed with placeholder image **5614** (a blank space) in a location that corresponds to the portion of virtual box **5064** that extends beyond the field of view of the device camera. For example, the placeholder image **5614** is displayed at a location in the augmented reality environment that is beyond the field of view of the camera, so no camera data is available to be displayed in the space occupied by the placeholder image **5614**.

[0369] FIGS. **5**F **10**-**5**F **11** illustrate movement of device **100** (back to the position of device **100** illustrated in FIGS. **5**F**8** and **5**F3).

[0370] FIGS. **5**F**11***a*-**5**F **12***a* illustrate movement of device **100** (e.g., backing away from table **5204***a* and physical object **5602**, such that device **100** appears larger). In FIG. **5**F**12***b*, as a result of the movement illustrated in **5**F**11***a*-**5**F**12***a*, the size of virtual object **5604** has decreased from the size of virtual object **5604** in FIG. **5**F**11***b*. The movement is shown in FIGS. **5**F**11***a*-**5**F**12***a* for illustrative purposes (such that the size of virtual object **5604** in FIG. **5**F**12***b*, in the stabilized mode, is the same as the size of virtual object **5604** in FIG. **5**F**3***b*, in the non-stabilized mode) to provide a straightforward comparison of updating of the augmented reality environment in the stabilized and non-stabilized modes of operation.

[0371] FIGS. **5**F**12***a*-**5**F**13***a* illustrate movement of device **100** relative to table **5204***a* and physical box **5602** that occurs while the augmented reality environment is displayed by device **100** in a stabilized mode of operation. When device **100** is at a first position relative to table **5204***a*, as shown in FIG. **5**F **12***a*, the rendered version **5604** of physical object **5602** is fully visible in the user interface shown in FIG. **5**F**12***b*. In FIG. **5**F**13***a*, device **100** has been moved to a second position relative to table **5204***a* and the rendered version **5604** of physical object **5602** is only partially visible in the user interface shown in FIG. **5**F**13***b*. In some embodiments, in the stabilized mode of operation, as device **100** moves, the view of virtual box **5604** changes so as to maintain a fixed spatial relationship between virtual box **5604** and physical box **5602** and the displayed representation of the field of view of the camera of device **100** (e.g., including displayed table **5204***b*) changes by an amount that is less than the amount of change that occurs in the non-stabilized mode (e.g., the amount of movement of displayed table **5204***b* from FIG. **5**F**12***b*-**5**F**13***b*, while device **100** is in the stabilized mode of operation, is less than the amount of movement of displayed table **5204***b* from FIG. **5**F**4***b* to **5**F**5***b*, while device **100** is in the non-stabilized mode of operation).

[0372] FIGS. **5**F**14**-**5**F**16** illustrate an input at a stabilization toggle **5616** to transition from a non-stabilized mode of operation to a stabilized mode of operation. In FIG. **5**F**15***b*, an input (e.g., a tap input) by contact **5618** is detected at a location on touch screen display **112** to corresponds to stabilization toggle **5616**. In response to the input by contact **5618**, the appearance of stabilization toggle **5616** is changed (e.g., the toggle changes from an unshaded state to a shaded state) to indicate that a transition from a non-stabilized mode of operation to a stabilized mode of operation has occurred, as shown in FIG. **5**F**16***b*.

[0373] FIGS. **5**F **16***a*-**5**F **17***a* illustrate movement of device **100** relative to table **5204***a* and physical box **5602** that occurs while the augmented reality environment is displayed by device **100** (as shown in FIGS. **5**F**16***a*-**5**F**17***a*) in a stabilized mode of operation. When device **100** is at a first position relative to table **5204***a*, as shown in FIG. **5**F**16***a*, the rendered version **5604** of physical object **5602** is fully visible in the user interface shown in FIG. **5**F**16***b*. In FIG. **5**F**17***a*, device **100** has been moved to a second position relative to table **5204***a* and the rendered version **5604** of physical object **5602** is only partially visible in the user interface shown in FIG. **5**F **17***b*. In the stabilized mode of operation, as device **100** moves, the view of virtual box **5604** changes so as to maintain a fixed spatial relationship between virtual box **5604** and physical box **5602** and the displayed representation of the field of view of the camera of device **100** (e.g., including displayed table **5204***b*) changes by an amount that is less than the amount of change that occurs in the non-stabilized mode (e.g., the amount of movement of displayed table **5204***b* from FIG. **5**F**15***b*-**5**F**16***b*, while device **100** is in the stabilized mode of operation, is less than the amount of movement of displayed table **5204***b* from FIG. **5**F**4***b* to **5**F**5***b*, while device **100** is in the non-stabilized mode of operation).

[0374] FIGS. **6**A-**6**D are flow diagrams illustrating method **600** of adjusting an appearance of a virtual user interface object in an augmented reality environment, in accordance with some embodiments. Method **600** is performed at a computer system (e.g., portable multifunction device **100**, FIG. **1**A, device **300**, FIG. **3**A, or a multi-component computer system including headset **5008** and input device **5010**, FIG. **5A2**) having a display generation component (e.g., a display, a projector, a heads-up display, or the like), one or more cameras (e.g., video cameras that continuously provide a live preview of at least a portion of the contents that are within the field of view of the cameras and optionally generate video outputs including one or more streams of image frames capturing the contents within the field of view of the cameras), and an input device (e.g., a touch-sensitive surface, such as a touch-sensitive remote control, or a touch-screen display that also serves as the display generation component, a mouse, a joystick, a wand controller, and/or cameras tracking the position of one or more features of the user such as the user's hands). In some embodiments, the input device (e.g., with a touch-sensitive surface) and the display generation component are integrated into a touch-sensitive display. As described above with respect to FIGS. 3B-3D, in some embodiments, method **600** is performed at a computer system **301** (e.g., computer system **301**-*a*, **301**-*b*, or **301**-*c*) in which respective components, such as a display generation component, one or more cameras, one or more input devices, and optionally one or more attitude sensors are each either included in or in communication with computer system **301**.

[0375] In some embodiments, the display generation component is a touch-screen display and the input device (e.g., with a touch-sensitive surface) is on or integrated with the display generation component. In some embodiments, the display generation component is separate from the input device (e.g., as shown in FIG. **4**B and FIG. **5A2**). Some operations in method **600** are, optionally, combined and/or the order of some operations is, optionally, changed.

[0376] For convenience of explanation, some of the embodiments will be discussed with reference to operations performed on a computer system with a touch-sensitive display system **112** (e.g., on device **100** with touch screen **112**) and one or more integrated cameras. However, analogous operations are, optionally, performed on a computer system (e.g., as shown in FIG. **5A2**) with a headset **5008** and a separate input device **5010** with a touch-sensitive surface in response to detecting the contacts on the touch-sensitive surface of the input device **5010** while displaying the user interfaces shown in the figures on the display of headset **5008**. Similarly, analogous operations are, optionally, performed on a computer system having one or more cameras that are implemented separately (e.g., in a headset) from one or more other components (e.g., an input device) of the computer system; and in some such embodiments, "movement of the computer system" corresponds to movement of one or more cameras of the computer system, or movement of one or more cameras in communication with the computer system.

[0377] As described below, method **600** relates to adjusting an appearance of a virtual user interface object (on a display of a computer system), in an augmented reality environment (e.g., in which reality is augmented with supplemental information that provides additional information to the user that is not available in the physical world), based on a combination of movement of the computer system (e.g., movement of one or more cameras of the computer system) and movement of a contact on an input device (e.g., a touch-screen display) of the computer system. In some embodiments, adjusting the appearance of the virtual user interface object allows the user to access the supplemental information in the augmented reality environment. Adjusting an appearance of a virtual user interface object based on a combination of movement of the computer system and movement of a contact on an input device of the computer system provides an intuitive way for the user to adjust the appearance of the virtual user interface object (e.g., by allowing the user to adjust the appearance of the virtual user interface object with only movement of the computer system, with only movement of a contact on the input device, or with a combination of movement of the computer system and movement of the contact) and allows the user to extend the range of adjustments available to the user (e.g., by allowing the user to continue adjusting the appearance of the virtual user interface object even if the contact or the one or more cameras of the computer system cannot move further in the desired direction), thereby enhancing the operability of the device and making the user-device interface more efficient (e.g., by reducing the number of steps that are needed to achieve an intended outcome when operating the device and reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0378] The computer system (e.g., device **100**, FIG. **5A7**) displays (**602**), via the display generation component (e.g., touch screen **112**, FIG. **5A7**), an augmented reality environment (e.g., as shown in FIG. **5A7**). Displaying the augmented reality environment includes (**604**) concurrently displaying: a representation of at least a portion of a field of view of the one or more cameras that includes a respective physical object (e.g., a 3D model of a building, a sheet of paper with a printed pattern, a poster on a wall or other physical object, a statue sitting on a surface, etc.) (e.g., physical building model **5006**, FIG. **5A1**), wherein the representation is updated as contents of the field of view of the one or more cameras change (e.g., the representation is a live preview of at least a portion of the field of view of the one or more cameras, and the respective physical object is included and visible in the field of view of the cameras); and a respective virtual user interface object (e.g., a virtual roof of the 3D model of the building, a virtual car parked on a surface represented by the sheet of paper with the printed pattern, an interactive logo overlaid on the poster, a virtual 3D mask covering the contours of the statue, etc.) (e.g., virtual building model **5012**, FIG. **5A7**) at a respective location in the representation of the field of view of the one or more cameras, wherein the respective virtual user interface object (e.g., virtual building model **5012**, FIG. **5A7**) has a location that is determined based on the respective physical object (e.g., physical building model **5006**) in the field of view of the one or more cameras. For example, in some embodiments, the respective virtual user interface object is a graphical object or a 2D or 3D virtual object that appears to be attached to, or that appears to cover, the respective physical object in the field of view of the one or more cameras (e.g., virtual building model **5012** is a 3D virtual object that appears to cover physical building model **5006**, FIG. **5A7**). The location and/or orientation of the respective virtual user interface object is determined based on the location, shape, and/or orientation of the physical object in the field of view of the one or more cameras (e.g., as shown in FIGS. **5A3** and **5A5**). While displaying the augmented reality environment (**606**), the computer system detects an input (e.g., detects the input on the input device such as by detecting a touch input by a contact on a touch-screen display or a touch-sensitive remote control) at a location (e.g., a location on the touch-screen display or the touch-sensitive remote control, or movement of a wand or a user's hands while a cursor is at a location of the respective virtual user interface object) that corresponds to the respective virtual user interface object (e.g., device **100** detects contact **5020**-*a* on the virtual roof of virtual building model **5012**, FIG. **5A8**).

[0379] While continuing to detect the input (**608**) (e.g., while the contact is maintained on the input device such as while the contact is maintained on the touch-screen display or on the touch-sensitive remote control) (e.g., while contact **5020** is maintained on touch screen **112**, FIGS. **5A9-5A13**), the computer system detects movement of the input relative to the respective physical object in the field of view of the one or more cameras (e.g., as shown in FIGS. **5A9-5A13**). In some embodiments, the movement of the input optionally includes movement of the contact across the touch-screen display or across the touch-sensitive surface of the touch-sensitive remote control while the computer system (e.g., device **100**) is held substantially stationary in the physical space (e.g., as shown in FIGS. **5A8-5A11**). In some embodiments, the movement of the input optionally includes movement of the device including the cameras in the physical space while the contact is maintained and kept stationary on the touch-screen display or touch-sensitive remote control (e.g., as shown in FIGS. **5A17-5A18**). In some embodiments, the movement of the input optionally includes concurrent movement of the contact across the touch-screen display or touch-sensitive remote control and movement of the device including the cameras in the physical space. In some embodiments, the movement of the computer system includes movement of a component of a multi-component computer system, such as movement of a virtual reality display headset, etc. (e.g., as shown in FIG. **5A2**). In addition, while continuing to detect the input, and in response to detecting the movement of the input relative to the respective physical object in the field of view of the one or more cameras, the device adjusts an appearance of the respective virtual user interface object (e.g., by expanding, contracting, stretching, squeezing together, spreading out, and/or pushing together, all or part(s) of the virtual user interface object) in accordance with a magnitude of movement of the input relative to the respective physical object. For example, when the contact is detected over the virtual roof of the building model and then moves across the touch-screen display, the virtual roof is lifted away from the building model in the live preview of the field of view of the cameras (e.g., as shown in FIGS. **5A8-5A11**); and while the contact is maintained on the touch-screen display, and the device as a whole is moved relative to the building model in the physical space, the movement of the virtual roof is determined based on both the location of the contact on the touch-screen display, and the location and orientation of the device relative to the respective physical object in the physical space (e.g., as determined based on the location of the respective physical object shown in the live preview of the field of view of the cameras) (e.g., as shown in FIGS. **5A11-5A13**).

[0380] As another example, in a block building application (e.g., as described in further detail with respect to FIGS. **5B 1-5B41**) in which a virtual model is built on the respective physical object (e.g., a table top or a sheet of paper with a printed pattern), when the contact is detected on a block (e.g., in response to a long-press input on the block) (e.g., contact **5262**, FIG. **5B28**) and the computer system displays a guide for how the block will scale (e.g., as shown using resizing projections **5266**, FIG. **5B29**), while the contact is maintained on the block, and the device as a whole is moved relative to the block (e.g., as shown in FIGS. **5B28-5B30**), the scaling of the block (e.g., stretching of the block in the direction of the guide) is determined based on both the location of the contact on the touch-screen display (e.g., on a particular side or face of the block cube) and the location and orientation of the device relative to the respective physical object in the physical space (e.g., as determined based on the location of the respective physical object shown in the live preview of the field of view of the cameras).

[0381] In some embodiments, adjusting the appearance of the respective virtual user interface object (e.g., virtual building model **5012**, FIGS. **5A8-5A13**) in accordance with the magnitude of movement of the input relative to the respective physical object includes (**610**): in accordance with a determination that the magnitude of movement of the input relative to the respective physical object is a first magnitude (e.g., a relatively larger magnitude of movement), adjusting the appearance of the respective virtual user interface object by a first adjustment (e.g., a larger amount of relative movement causes a larger adjustment) (e.g., as shown in FIG. **5A10**, compared to FIG. **5A9**); and in accordance with a determination that the magnitude of movement of the input relative to the respective physical object is a second magnitude distinct from the first magnitude (e.g., a relatively smaller magnitude of movement), adjusting the appearance of the respective virtual user interface object by a second adjustment distinct from the first adjustment (e.g., a smaller amount of relative movement causes a smaller adjustment) (e.g., as shown in FIG. **5A9**, compared to FIG. **5A10**). Adjusting the respective virtual user interface object by a first adjustment when the magnitude of movement of the input is a first magnitude (e.g., a larger amount of relative movement causes a larger adjustment) and adjusting the respective virtual user interface object by a second adjustment when the magnitude of movement of the input is a second magnitude (e.g., a smaller amount of relative movement causes a smaller adjustment) improves the visual feedback provided to the user (e.g., by making the computer system appear more responsive to user input), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by helping the user to achieve an intended outcome with the required inputs and reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0382] In some embodiments, the respective virtual user interface object (e.g., virtual building model **5012**, FIGS. **5A3-5A6**) is (**612**) anchored, before and after the adjusting, to the respective physical object (e.g., physical building model **5006**) in the field of view of the one or more cameras. For example, in some embodiments, the respective virtual user interface object appears to cover the respective physical object in the field of view of the one or more cameras, and when the location and/or orientation of the physical object in the field of view of the one or more cameras changes, the location and/or orientation of the respective virtual user interface object changes accordingly (e.g., as shown in FIGS. **5A3-5A6**). In some embodiments, the respective virtual user interface object is anchored to the respective physical object in the field of view of the one or more cameras during some or all of the adjusting (e.g., during a transition from FIG. **5A3** to FIG. **5A5**). Anchoring the respective virtual user interface object to the respective physical object improves the visual feedback provided to the user (e.g., by making the computer system appear more responsive to user input), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by helping the user to achieve an intended outcome with the required inputs and reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0383] In some embodiments, the appearance of the respective virtual user interface object is (**614**) adjusted in response to detecting the movement of the input relative to the respective physical object in the field of view of the one or more cameras without regard to whether the movement of the input is due to: movement of the input on the input device (e.g., movement of a contact across the touch-screen display or across the touch-sensitive surface of the input device while the input device is held substantially stationary in the physical space) (e.g., as shown in FIGS. **5A9-5A11**), movement of the one or more cameras relative to the respective physical object (e.g., movement of the computer system including the cameras in the physical space while the contact is maintained and kept stationary on the touch-screen display or touch-sensitive surface of the input device) (e.g., as shown in FIGS. **5A11-5A13**), or a combination of the movement of the input on the input device and the movement of the one or more cameras relative to the respective physical object (e.g., concurrent movement of the contact across the touch-screen display or touch-sensitive surface of the input device and movement of the computer system including the cameras in the physical space). Adjusting the appearance of the virtual user interface object without regard to the manner of movement of the input (e.g., by allowing the user to adjust the appearance of the virtual user interface object with only movement of the input on the input device, with only movement of the cameras relative to the physical object, or with a combination of movement of the input and the cameras) provides an intuitive way for the user to adjust the appearance of the virtual user interface object, improves the visual feedback provided to the user (e.g., by making the computer system appear more responsive to user input), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by helping the user to achieve an intended outcome with the required inputs and reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0384] In some embodiments, the movement of the input relative to the respective physical object is (**616**) based on movement of the field of view of the one or more cameras relative to the respective physical object (e.g., as a result of movement of the computer system including the cameras in the physical space) (e.g., as shown in FIGS. **5A11-5A13**) and movement of the input on the input device (e.g., movement of a contact across the touch-screen display or across the touch-sensitive surface of the input device) (e.g., as shown in FIGS. **5A8-5A11**). Allowing the user to move the input relative to the respective physical object by movement of the computer system and movement of a contact provides an intuitive way for the user to move the input, improves the feedback provided to the user (e.g., by making the computer system appear more responsive to user input), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by helping the user to achieve an intended outcome with the required inputs and reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0385] In some embodiments, the movement of the input relative to the respective physical object is (**618**) based on movement of the input on the input device (e.g., movement of a contact across the touch-screen display or across the touch-sensitive surface of the input device while the input device is held substantially stationary in the physical space) (e.g., as shown in FIGS. **5A8-5A11**), and the computer system, after adjusting the appearance of the respective virtual user interface object in accordance with the magnitude of movement of the input relative to the respective physical object (e.g., as shown in FIG. **5A11**): detects movement of the field of view of the one or more cameras relative to the respective physical object (e.g., movement **5022**, FIG. **5A12**); and in response to detecting the movement of the field of view of the one or more cameras relative to the respective physical object, continues to adjust the appearance of the respective virtual user interface object (e.g., in the same manner) in accordance with a magnitude of movement of the field of view of the one or more cameras relative to the respective physical object (e.g., as shown in FIG. **5A13**). In some embodiments, adjusting the appearance of the respective virtual user interface object includes moving part of the respective virtual user interface object, where the movement is started by a contact dragging on the virtual user interface object and the movement is continued by moving the device as a whole (e.g., as shown in FIGS. **5A8-5A13**). For example, when a contact is detected over the virtual roof of a 3D model of a building and the contact moves across the touch-screen display (e.g., in an upward direction), the virtual roof is lifted up from the building model in the displayed augmented reality environment (e.g., as shown in FIGS. **5A8-5A11**). After the virtual roof is lifted up, when the device as a whole is moved relative to the building model in the physical space (e.g., in an upward direction), the virtual roof continues to lift up (e.g., as shown in FIGS. **5A11-5A13**) (and optionally, floors of the building model lift up and expand). In some embodiments, adjusting the appearance of the respective virtual user interface object in accordance with the magnitude of movement of the input and then continuing to adjust the appearance of the respective virtual user interface object in accordance with a magnitude of movement of the field of view of the one or more cameras allows the user to continue adjusting the appearance of the respective virtual user interface object even if the contact cannot move much further in the desired direction on the touch-screen display (e.g., because the touch is at or near an edge of the touch-screen display and further movement of the touch would move the touch off of the edge of the touch-screen display). For example, with the virtual roof, when the contact gets close to the top edge of the touch-screen display but the user still wants to continue lifting the roof, the user can do so by moving the device or cameras to continue the adjustment even if the contact cannot move much higher on the touch-screen display (e.g., as shown in FIGS. **5A8-5A13**). Adjusting the appearance of the respective virtual user interface object in accordance with the magnitude of movement of the input and then continuing to adjust the appearance of the respective virtual user interface object in accordance with a magnitude of movement of the field of view of the one or more cameras allows the user to extend the range of adjustments available to the user (e.g., allowing the user to continue adjusting the appearance of the respective virtual user interface object with movement of the computer system, even if the contact cannot move much further in the desired direction on the touch-screen display), thereby enhancing the operability of the device and making the user-device interface more efficient (e.g., by reducing the number of steps that are needed to achieve an intended outcome when operating the device and reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0386] In some embodiments, the movement of the input relative to the respective physical object is (**620**) based on movement of the field of view of the one or more cameras relative to the respective physical object (e.g., as a result of movement of one or more cameras of the computer system, or one or more cameras in communication with the computer system, in the physical space while a contact is maintained and kept stationary on the touch-screen display or touch-sensitive surface of the input device) (e.g., as shown in FIGS. **5A17**-**5A18**), and the computer system, after adjusting the appearance of the respective virtual user interface object in accordance with the magnitude of movement of the input relative to the respective physical object (e.g., as shown in FIG. **5A18**): detects movement of the input on the input device (e.g., movement of the (previously stationary) contact across the touch-screen display or across the touch-sensitive surface of the input device while the input device is held substantially stationary in the physical space) (e.g., as shown in FIGS. **5A19**-**5A20**); and in response to detecting the movement of the input on the input device, continues to adjust the appearance of the respective virtual user interface object (e.g., in the same manner) in accordance with a magnitude of movement of the input on the input device (e.g., as shown in FIG. **5A20**). In some embodiments, adjusting the appearance of the respective virtual user interface object includes moving part of the respective virtual user interface object (e.g., moving virtual roof **5012**-*a*, FIGS. **5A17**-**5A20**), where the movement is started by a (stationary) contact touch on the virtual user interface object and moving the device as a whole (e.g., as shown in FIGS. **5A17**-**5A18**), and the movement is continued by the contact dragging on the virtual user interface object (e.g., as shown in FIGS. **5A19**-**5A20**). For example, when a contact is detected over the virtual roof of a 3D model of a building and the device as a whole is moved relative to the building model in the physical space (e.g., in an upward direction), the virtual roof is lifted up from the building model in the live preview of the field of view of the cameras (e.g., as shown in FIGS. **5A17**-**5A18**). After the virtual roof is lifted up, when the (previously stationary) contact moves across the touch-screen display (e.g., in an upward direction), the virtual roof continues to lift up (and optionally, floors of the building model lift up and expand) (e.g., as shown in FIGS. **5A19**-**5A20**). Adjusting the appearance of the respective virtual user interface object in accordance with the magnitude of movement of the field of view of the one or more cameras and then continuing to adjust the appearance of the respective virtual user interface object in accordance with a magnitude of movement of the input on the input device allows the user to extend the range of adjustments available to the user (e.g., allowing the user to continue adjusting the appearance of the respective virtual user interface object with the input device, even if the computer system (or the one or more cameras of, or in communication with, the computer system) cannot move much further in the desired direction), thereby enhancing the operability of the device and making the user-device interface more efficient (e.g., by reducing the number of steps that are needed to achieve an intended outcome when operating the device and reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0387] In some embodiments, detecting the input at the location that corresponds to the respective virtual user interface object includes (**622**) detecting the input at a first contact point on the respective virtual user interface object; and the computer system (e.g., device **100**) updates the display of the respective virtual user interface object so as to maintain display of the first contact point on the respective virtual user interface object at a location that corresponds to a location of the input (e.g., when the virtual user interface object is displayed on a touch-screen device, the device updates the respective virtual user interface so as to keep the virtual user interface object under the user's finger without regard to whether the movement of the input is due to movement of the input on the input device (e.g., movement of a contact across the touch-screen display or across the touch-sensitive surface of the input device while the input device is held substantially stationary in the physical space) (e.g., as shown in FIGS. **5A8**-**5A11**), movement of the one or more cameras relative to the respective physical object (e.g., movement of the computer system including the cameras in the physical space while the contact is maintained and kept stationary on the touch-screen display or touch-sensitive surface of the input device) (e.g., as shown in FIGS. **5A11**-**5A13**), or a combination of the movement of the input on the input device and the movement of the one or more cameras relative to the respective physical object (e.g., concurrent movement of the contact across the touch-screen display or touch-sensitive surface of the input device and movement of the computer system including the cameras in the physical space)). For example, when a contact (e.g., by a user's finger) is detected "on" the virtual roof of a 3D model of a building (e.g., detected on touch screen **112** at a location at which the virtual roof of the 3D model of the building is displayed), movement on the touch-screen display and movement of the computer system are synced to keep the contact at the same point on the virtual roof (e.g., the virtual roof lifts up and remains under the user's finger as the contact moves across the touch-screen display in an upward direction, the virtual roof lifts up and remains under the user's finger as the device as a whole is moved in an upward direction relative to the building model in the physical space, the virtual roof remains under the user's finger (e.g., moving up or down) based on a combination of the movement of the contact and movement of the device as a whole, etc.) (e.g., as shown in FIGS. **5A8**-**5A13**). Maintaining display of the contact point on the respective virtual user interface object at a location that corresponds to a location of the input improves the visual feedback provided to the user (e.g., by making the computer system appear more responsive to user input), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by helping the user to achieve an intended outcome with the required inputs and reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0388] In some embodiments, movement of the input relative to the respective physical object includes (**624**) movement of the computer system (e.g., movement of the computer system, including the one or more cameras, in the physical space) (e.g., as shown in FIG. **5A17**); and movement of the computer system is derived (e.g., determined) from image analysis that indicates one or more reference points within the field of view of the one or more cameras have changed (e.g., the movement of the computer system is determined from the changed location or position of one or more reference points within the field of view of the one or more cameras) between successive images captured by the one or more cameras (e.g., comparison of consecutive image frames and tracking the objects identified in the images). In some embodiments, the image analysis is performed by the computer system. In some embodiments, the image analysis includes tracking three or more points of reference within the field of view of the cameras. In some embodiments, new points of reference are identified as old points of reference move out of the field of view of the one or more cameras. In some embodiments, a determination of movement of the computer system is derived from image analysis instead of derived from using an inertial measurement unit (IMU) of the computer system. In some embodiments, movement of the computer system is derived from image analysis in addition to using one or more elements of an IMU of the computer system (e.g., an accelerometer, a gyroscope, and/or a magnetometer). Detecting movement of the computer system from image analysis improves the feedback provided to the user (e.g., by making the computer system appear more responsive to user input), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by helping the user to achieve an intended outcome with the required inputs and reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0389] In some embodiments, adjusting the appearance of the respective virtual user interface object includes (**626**) moving at least a portion of the respective virtual user interface object, wherein movement of the respective virtual user interface object is based on a physical shape of the respective physical object (e.g., based on the shape of the physical model). For example, in some embodiments, the respective physical object is a 3D highway model and the respective virtual user interface object is a virtual car. In this example, adjusting the appearance of the virtual car includes moving the virtual car on the 3D highway model and movement of the virtual car is based on the physical shape of the 3D highway model (e.g., the virtual car moves on a ramp of the 3D highway model). As another example, in some embodiments, the respective physical object is a physical building model (e.g., physical building model **5006**, FIG. **5A1**) and the respective virtual user interface object is a virtual building model (e.g., virtual building model **5012**, FIG. **5A8**), and adjusting the appearance of the respective virtual user interface object includes moving at least a portion of the respective virtual user interface object (e.g., virtual roof **5012**-*a*, FIG. **5A9**). Moving the respective virtual user interface object based on the physical shape of the respective physical object improves the feedback provided to the user (e.g., by making the computer system appear more responsive to user input), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by helping the user to achieve an intended outcome with the required inputs and reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0390] In some embodiments, adjusting the appearance of the respective virtual user interface object includes (**628**) moving at least a portion of the respective virtual user interface object, wherein movement of the respective virtual user interface object is based on concurrent movement of one or more touch inputs (e.g., swipe inputs on the input device) and movement of the computer system. For example, in some embodiments, adjusting the appearance of a virtual roof of a 3D model of a building includes moving at least a portion of the virtual roof, where movement of the virtual roof is based on concurrent movement of a contact moving across the touch-screen display (e.g., in an upward direction) and movement of the device as a whole relative to the building model in the physical space (e.g., in an upward direction) (e.g., if the device movement **5028** in FIGS. **5A17**-**5A18** occurred concurrently with the movement of contact **5026** in FIGS. **5A19**-**5A20**). As another example, in some embodiments, movement of a virtual car is based on concurrent movement of dragging the virtual car on a ramp of a 3D highway model and movement of the model itself on the display because the device is moving. Allowing the user to move the respective virtual user interface object by concurrent movement of touch inputs and movement of the computer system provides an intuitive way for the user to move the respective virtual user interface object, improves the feedback provided to the user (e.g., by making the computer system appear more responsive to user input), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by helping the user to achieve an intended outcome with the required inputs and reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0391] In some embodiments, adjusting the appearance of the respective virtual user interface object includes (**630**) moving at least a portion of the respective virtual user interface object beyond a maximum limit of a resting state of the respective virtual user interface object (e.g., moving virtual roof **5012**-*a* beyond a maximum limit of its resting state, as shown in FIG. **5A13**) (e.g., based on movement of a contact across the touch-screen display or across the touch-sensitive surface of the input device, movement of the one or more cameras relative to the respective physical object, or a combination of the movement of the contact on the input device and the movement of the one or more cameras relative to the respective physical object), and the computer system: while continuing to detect the input, displays the respective virtual user interface object at a location beyond the maximum limit of the resting state of the respective virtual user interface object, in accordance with the magnitude of movement of the input relative to the respective physical object (e.g., as shown in FIG. **5A13**); ceases to detect the input (e.g., liftoff of contact **5020**-*d* in FIG. **5A13**); and in response to ceasing to detect the input, displays the respective virtual user interface object at a location corresponding to the maximum limit of the resting state of the respective virtual user interface object (e.g., as shown in FIG. **5A14**). In some embodiments, this includes displaying an animated transition from the respective virtual user interface object at the location beyond the maximum limit of the resting state to the location corresponding to the maximum limit of the resting state (e.g., displaying an animated transition from virtual roof **5012**-*a* at the location in FIG. **5A13** to virtual roof **5012**-*a* at the location in FIG. **5A14**). In some embodiments, if the respective virtual user interface object moves beyond a furthest extent of its maximum resting state based on movement of the input, the respective virtual user interface object snaps back (e.g., in an animated transition) to its maximum resting state when the input lifts off. For example, if a virtual roof of a 3D building model can be displayed resting directly on the 3D building model and hovering up to twelve inches above the building model (e.g., the resting state of the virtual roof is between zero and twelve inches from the building model), if a user lifts the virtual roof fifteen inches above the building model, when the user input lifts off, the virtual roof snaps back to twelve inches above the building model. Moving the respective virtual user interface object in accordance with the magnitude of movement of the input (even if beyond the maximum limit of the resting state of the respective virtual user interface object) and then displaying the respective virtual user interface object snapping back to its maximum resting state when the input lifts off improves the feedback provided to the user (e.g., by making the computer system appear more responsive to user input), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by helping the user to achieve an intended outcome with the required inputs and reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0392] In some embodiments, the displayed augmented reality environment includes (**632**): one or more virtual objects that do not correspond to physical objects in the field of view of the one or more cameras (e.g., virtual cars driving in front of a virtual building that is a replacement for a physical model of a building) (e.g., virtual trees, virtual bushes, a virtual person, and a virtual car in the augmented reality environment shown in FIG. **5A4**); one or more physical objects that are in the field of view of the one or more cameras (e.g., a table on which a physical model of a building is sitting) (e.g., table **5004** and wallpaper **5007**, FIG. **5A4**); and one or more 3D virtual models of the one or more physical objects that are in the field of view of the one or more cameras that replace at least a portion of the corresponding one or more physical objects (e.g., virtual building model **5012**, FIG. **5A4**) (e.g., a replacement for a physical model of a building) (e.g., a respective 3D virtual model is projected onto a corresponding respective physical marker). In some embodiments, a respective 3D virtual model of a respective physical object in the field of view of the one or more cameras replaces a portion (but not all) of the corresponding respective physical object (e.g., a 3D virtual model of a statue's head replaces a portion of the physical statue's head in the field of view of the one or more cameras, showing an interior cross section of one quarter of the head, for example). In some embodiments, a respective 3D virtual model of a respective physical object in the field of view of the one or more cameras replaces all of the corresponding respective physical object (e.g., a 3D virtual model of a building replaces the entire physical model of the building in the field of view of the one or more cameras) (e.g., virtual building model **5012** replaces the entire physical building model **5006** in the augmented reality environment, FIG. **5A4**). In some embodiments, the displayed augmented reality environment includes all three of the above (e.g., pure virtual objects, physical objects, and 3D virtual models of the physical objects) in different layers. For example, in some embodiments, the displayed augmented reality environment includes a statue in a museum (e.g., a physical object in the field of view of the one or more cameras) with a 3D virtual model of the statue's head (e.g., a 3D virtual model of the statue's head showing an interior cross section of the statue) in a virtual environment with Egyptian pyramids (e.g., pure virtual objects showing the surroundings of where the statue was originally displayed).

[0393] In some embodiments, the displayed augmented reality environment includes a subset of the above (e.g., including one or more physical objects that are in the field of view of the one or more cameras and one or more 3D virtual models of the one or more physical objects, but not one or more pure virtual objects). For example, using the example above of the statute in the museum, in some embodiments, the displayed augmented reality environment includes the statue in the museum with a 3D virtual model of the statue's head, but does not include any pure virtual objects. As another example, in some embodiments, the displayed augmented reality environment includes a physical 3D model of a building on a table or platform (e.g., physical objects in the field of view of the one or more cameras) with a 3D virtual model of at least part of the building (e.g., a 3D virtual model of a portion of the building showing an interior view of the building) in a virtual outdoor environment (e.g., with virtual objects such as virtual trees surrounding the building, virtual cars driving in front of the building, or virtual people walking around the building). As the physical 3D model of the building moves in the field of view (e.g., as a result of movement in the physical world of the building model and/or as a result of movement of the computer system, for example, as the user moves the computer system by walking around to a different side of the physical building model) (e.g., as shown in FIGS. **5A3**-**5A6**), the one or more 3D virtual models of the physical 3D model of the building move accordingly. For example, as the user moves around to a different side of the building, the 3D virtual model of the portion of the building showing the interior view of the building changes to correspond to the updated view of the physical objects in the field of view of the one or more cameras. Displaying the augmented reality environment with virtual objects, physical objects, and 3D virtual models of the physical objects provides a realistic view (with one or more physical objects that are in the field of view of the one or more cameras) along with supplemental information (with one or more virtual objects and one or more 3D virtual models) that provides information to the user, thereby enhancing the operability of the device (e.g., by allowing the user to easily access supplemental information about the one or more physical objects that are in the field of view of the one or more cameras) and making the user-device interface more efficient (e.g., by helping the user to achieve an intended outcome with the required inputs and reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0394] In some embodiments, the respective physical object is (**634**) a 3D marker that is recognizable from different angles and the respective virtual user interface object is a 3D virtual model that is overlaid on the respective physical object (e.g., in the displayed augmented reality environment) based on a camera angle of the one or more cameras. In some embodiments, the camera angle of the one or more cameras corresponds to an orientation of the one or more cameras relative to the respective physical object. For example, using the example above where the displayed augmented reality environment includes a statue in a museum with a 3D virtual model of the statue's head, when the camera angle of the one or more cameras is positioned to include the front of the statue in the field of view of the one or more cameras, the displayed augmented reality environment includes the front of the statue and the 3D virtual model of the front of the statue's head. As the camera angle changes (e.g., as the user of the device walks around the statue in the museum while viewing the statue in the field of view of the one or more cameras) and the camera angle of the one or more cameras is positioned to include the back of the statue in the field of view of the one or more cameras, the displayed augmented reality environment includes the back of the statue and the 3D virtual model of the back of the statue's head. As the respective physical object moves in the field of view (e.g., as a result of movement in the physical world of the respective physical object and/or as a result of movement of the computer system that causes movement of the respective physical object in the field of view of the one or more cameras), the 3D virtual model that is overlaid on the respective physical object moves accordingly (e.g., changes to follow the respective physical object). For example, using the example above where the displayed augmented reality environment includes a physical 3D building model on a table (e.g., physical building model **5006** on table **5004**, FIG. **5A1**) with a 3D virtual model of a portion of the building showing the building interior, when the physical 3D building model moves (e.g., in the field of view of the one or more cameras) (e.g., as user **5002** walks from a position as shown in FIG. **5A3** to a position as shown in FIG. **5A5**) the 3D virtual model of the building that is overlaid on the physical 3D building model moves accordingly (e.g., when the user walks around the physical 3D building model (e.g., from the front of the physical 3D building model to the side of the physical 3D building model) while viewing the building in the field of view of the one or more cameras, the 3D virtual model changes to display the interior portion of the building in the field of view of the one or more cameras from the user's new location (e.g., from displaying the interior of the front of the physical 3D building model to displaying the interior of the side of the physical 3D building model). Overlaying the 3D virtual model on the respective physical object based on a camera angle of the one or more cameras improves the feedback provided to the user (e.g., by making the computer system appear more responsive to user input), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by helping the user to achieve an intended outcome with the required inputs and reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0395] It should be understood that the particular order in which the operations in FIGS. **6A-6D** have been described is merely an example and is not intended to indicate that the described order is the only order in which the operations could be performed. One of ordinary skill in the art would recognize various ways to reorder the operations described herein. Additionally, it should be noted that details of other processes described herein with respect to other methods described herein (e.g., methods **700**, **800**, **900**, **1000**, **1100**, **1200**, and **1300**) are also applicable in an analogous manner to method **600** described above with respect to FIGS. **6A-6D**. For example, the contacts, gestures, user interface objects, intensity thresholds, focus indicators, and/or animations described above with reference to method **600** optionally have one or more of the characteristics of the contacts, gestures, user interface objects, intensity thresholds, focus indicators, and/or animations described herein with reference to other methods described herein (e.g., methods **700**, **800**, **900**, **1000**, **1100**, **1200**, and **1300**). For brevity, these details are not repeated here.

[0396] FIGS. **7A-7C** are flow diagrams illustrating method **700** of applying a filter on a live image captured by one or more cameras of a computer system in an augmented reality environment, in accordance with some embodiments. Method **700** is performed at a computer system (e.g., portable multifunction device **100**, FIG. **1A**, device **300**, FIG. **3A**, or a multi-component computer system including headset **5008** and input device **5010**, FIG. **5A2**) having a display generation component (e.g., a display, a projector, a heads-up display, or the like), one or more cameras (e.g., video cameras that continuously provide a live preview of at least a portion of the contents that are within the field of view of the cameras and optionally generate video outputs including one or more streams of image frames capturing the contents within the field of view of the cameras), and an input device (e.g., a touch-sensitive surface, such as a touch-sensitive remote control, or a touch-screen display that also serves as the display generation component, a mouse, a joystick, a wand controller, and/or cameras tracking the position of one or more features of the user such as the user's hands). In some embodiments, the input device (e.g., with a touch-sensitive surface) and the display generation component are integrated into a touch-sensitive display. As described above with respect to FIGS. **3B-3D**, in some embodiments, method **700** is performed at a computer system **301** in which respective components, such as a display generation component, one or more cameras, one or more input devices, and optionally one or more attitude sensors are each either included in or in communication with computer system **301**.

[0397] In some embodiments, the display generation component is a touch-screen display and the input device (e.g., with a touch-sensitive surface) is on or integrated with the display generation component. In some embodiments, the display generation component is separate from the input device (e.g., as shown in FIG. **4B** and FIG. **5A2**). Some operations in method **700** are, optionally, combined and/or the order of some operations is, optionally, changed.

[0398] For convenience of explanation, some of the embodiments will be discussed with reference to operations performed on a computer system with a touch-sensitive display system **112** (e.g., on device **100** with touch screen **112**). However, analogous operations are, optionally, performed on a computer system (e.g., as shown in FIG. **5A2**) with a headset **5008** and a separate input device **5010** with a touch-sensitive surface in response to detecting the contacts on the touch-sensitive surface of the input device **5010** while displaying the user interfaces shown in the figures on the display of headset **5008**.

[0399] As described below, method **700** relates to applying a filter to a representation of the field of view of one or more cameras of a computer system (e.g., a live preview of the field of view of the one or more cameras), in an augmented reality environment (e.g., in which reality is augmented with supplemental information that provides additional information to a user that is not available in the physical world), where the filter is selected based on a virtual environment setting for the augmented reality environment. Applying a filter in real-time on a live image captured by the one or more cameras provides an intuitive way for the user to interact with the augmented reality environment (e.g., by allowing the user to easily change a virtual environment setting (e.g., time of day, scene/environment, etc.) for the augmented reality environment) and allows the user to see the changes made to the virtual environment setting in real-time, thereby enhancing the operability of the device and making the user-device interface more efficient (e.g., by reducing the number of steps that are needed to achieve an intended outcome when operating the device and reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently. Additionally, changing the appearance of the view of the physical environment makes the virtual model more visible (e.g., as compared to a dark model on a very bright background) while still providing the user with information about the physical environment in which the virtual model has been placed.

[0400] The computer system (e.g., device **100**, FIG. **5A21**) displays (**702**), via the display generation component (e.g., touch screen **112**, FIG. **5A21**), an augmented reality environment (e.g., as shown in FIG. **5A21**). Displaying the augmented reality environment includes (**704**) concurrently displaying: a representation of at least a portion of a field of view of the one or more cameras that includes a respective physical object (e.g., a 3D model of a building, a sheet of paper with a printed pattern, a poster on a wall or other physical object, a statue sitting on a surface, etc.) (e.g., physical building model **5006**, FIG. **5A1**), wherein the representation is updated as contents of the field of view of the one or more cameras change (e.g., the representation is a live preview of at least a portion of the field of view of the one or more cameras, and the respective physical object is included and visible in the field of view of the cameras); and a respective virtual user interface object (e.g., a virtual roof of the 3D model of the building, a virtual car parked on the a surface represented by the sheet of paper with the printed pattern, an interactive logo overlaid on the poster, a virtual 3D mask covering the contours of the statue, etc.) (e.g., virtual building model **5012**, FIG. **5A21**) at a respective location in the representation of the field of view of the one or more cameras, wherein the respective virtual user interface object has a location that is determined based on the respective physical object in the field of view of the one or more cameras. For example, in some embodiments, the respective virtual user interface object is a graphical object or a 2D or 3D virtual object that appears to be attached to, or that appears to cover, the respective physical object in the field of view of the one or more cameras (e.g., virtual building model **5012** is a 3D virtual object that appears to cover physical building model **5006**, FIG. **5A21**). The location and/or orientation of the respective virtual user interface object is determined based on the location, shape, and/or orientation of the physical object in the field of view of the one or more cameras (e.g., as shown in FIGS. **5A3** and **5A5**). While displaying the augmented reality environment, the computer system detects (**706**) an input that changes a virtual environment setting (e.g., time of day, lighting angle, story, etc.) for the augmented reality environment (e.g., a swipe input that navigates through time in the augmented reality environment, as shown in FIGS. **5A21-5A24**) (e.g., selecting a different display setting among a plurality of display settings corresponding to the respective physical object that is in the field of view of the one or more cameras, as shown in FIGS. **5A25-5A27**). In response to detecting the input that changes the virtual environment setting, the computer system (**708**): adjusts an appearance of the respective virtual user interface object in accordance with the change made to the virtual environment setting for the augmented reality environment; and applies a filter to at least a portion of the representation of the field of view of the one or more cameras (e.g., the portion of the representation of the field of view of the one or more cameras that is not obscured by the respective virtual user interface object), wherein the filter is selected based on the change made to the virtual environment setting (e.g., applying overall color filter to darken the scene (e.g., as shown in FIG. **5A24**), adding shadows to both the respective physical object and the virtual objects based on the direction of the virtual Sun (e.g., as shown in FIGS. **5A21-5A23**), adding additional virtual objects to the scene (and/or removing virtual objects from the scene) based on the selected story (e.g., historical view, construction, day in the life of view, etc.) (e.g., as shown in FIGS. **5A25-5A27**), and changing the color temperature, brightness, contrast, clarity, transparency, etc. of the image output of the cameras before the image output is displayed in the live preview of the field of view of the cameras).

[0401] In some embodiments, applying the filter to at least a portion of the representation of the field of view of the one or more cameras causes (**710**) an appearance adjustment of the augmented reality environment that is in addition to the appearance adjustment of the respective virtual user interface object. In some embodiments, the filter is applied to the portion of the representation of the field of view of the one or more cameras that is not obscured by the respective virtual user interface object (e.g., in FIG. **5A24**, the filter is applied to wallpaper **5007**, which is not obscured by the virtual scene). For example, when the construction view is selected, the virtual roof may be removed (e.g., adjusting the appearance of the respective virtual user interface object) to show the inside of the physical building model (e.g., as shown in FIG. **5A27**) and a virtual scene showing the inside of the building under construction is overlaid on the live preview of the physical building model, while the surrounding physical environment is blurred out (e.g., using a filter). When a time-lapse animation is displayed showing the construction over a period of several days, light filters are applied to the portions of the live preview that are not obscured by the virtual scene, such that lighting changes throughout the days are applied to the physical objects surrounding the building model that are also included in the live preview (e.g., wallpaper **5007** is also darkened in night mode, FIG. **5A24**). In some embodiments, the filter is applied to the augmented reality environment, including the respective virtual user interface object. For example, in some embodiments, an overall color filter is applied to the entire representation of the field of view of the one or more cameras, including the portion that is occupied by the respective virtual user interface object. Adjusting the appearance of the augmented reality environment in addition to adjusting the appearance of the respective virtual user interface object improves the visual feedback provided to the user (e.g., by making the computer system appear more responsive to user input), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by helping the user to achieve an intended outcome with the required inputs and reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0402] In some embodiments, the virtual environment setting is (**712**) changed to a night mode; and applying the filter to at least a portion of the representation of the field of view of the one or more cameras includes: decreasing brightness of an image (or sequence of images) captured by the one or more cameras; and applying a color filter to the image (or sequence of images) captured by the one or more cameras (e.g., as shown in FIG. **5A24**). In some embodiments, the filters that are applied to the image captured by the one or more cameras are applied before the image output is displayed in a live preview of the field of view of the one or more cameras (e.g., before the image captured by the one or more cameras is displayed in the augmented reality environment), as discussed below with respect to operation (**726**). Applying a filter for night mode (e.g., by decreasing brightness and applying a color filter) improves the visual feedback provided to the user (e.g., by making the computer system appear more responsive to user input), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by reducing the number of steps that are needed to achieve an intended outcome when operating the device and reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0403] In some embodiments, the input that changes the virtual environment setting is (**714**) a swipe input (e.g., left to right or right to left) that navigates through time in the augmented reality environment. For example, in some embodiments, when a user swipes from left to right on the input device, the time of day in the augmented reality environment changes from day to night (e.g., in accordance with the speed and/or distance of the swipe input movement) (e.g., as shown in FIGS. **5A21**-**5A24**). Allowing the user to navigate through time in the augmented reality environment using a swipe input provides an intuitive way for the user to change the virtual environment setting, improves the feedback provided to the user (e.g., by making the computer system appear more responsive to user input), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by reducing the number of steps that are needed to achieve an intended outcome when operating the device and reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0404] In some embodiments, detecting the input that changes the virtual environment setting includes (**716**) detecting a movement of the input to change the virtual environment setting; adjusting the appearance of the respective virtual user interface object in accordance with the change made to the virtual environment setting for the augmented reality environment includes gradually adjusting the appearance of the respective virtual user interface object in accordance with the movement of the input to change the virtual environment setting; and applying the filter to at least a portion of the representation of the field of view of the one or more cameras includes gradually applying the filter in accordance with the movement of the input to change the virtual environment setting (e.g., as shown in FIGS. **5A21**-**5A24**). For example, in some embodiments, the filter is gradually applied based on movement of the input and the appearance of the respective virtual user interface object is gradually adjusted based on the speed and/or distance of movement of the input (e.g., movement of a contact on a touch-sensitive surface, movement of a wand, or movement of a hand of the user in view of a camera of the computer system) (e.g., movement of contact **5030** on touch screen **112**, FIGS. **5A21**-**5A24**). Gradually adjusting the appearance of the virtual user interface object and gradually applying the filter in accordance with movement of the input to change the virtual environment setting improves the visual feedback provided to the user (e.g., by making the computer system appear more responsive to user input), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by reducing the number of steps that are needed to achieve an intended outcome when operating the device and reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0405] In some embodiments, the respective virtual user interface object casts (**718**) a shadow on the respective physical object in the augmented reality environment. For example, in some embodiments, the virtual roof of a 3D model of a building casts a shadow on the 3D model of the building. As the time of day or lighting angle is changed (e.g., by changing the virtual environment setting), the shadow cast by the respective virtual user interface object on the respective physical object changes accordingly. For example, as shown in FIGS. **5A21**-**5A23**, as the time of day is changed, the shadow cast by virtual building model **5012** changes accordingly. Displaying the virtual user interface object with a shadow (e.g., cast on the physical object) in the augmented reality environment improves the visual feedback provided to the user (e.g., by making the augmented reality environment more realistic and making the computer system appear more responsive to user input as the user changes the virtual environment setting), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0406] In some embodiments, the respective physical object casts (**720**) a shadow on the respective virtual user interface object in the augmented reality environment. For example, in some embodiments, the 3D model of a building casts a shadow on a virtual car parked next to the building. As the time of day or lighting angle is changed (e.g., by changing the virtual environment setting or due to movement of the physical object), the shadow cast by the respective physical object on the respective virtual user interface object changes accordingly. For example, in some embodiments, as the time of day in the augmented reality environment changes from mid-day (e.g., when respective shadows of objects in the augmented reality environment are relatively small) to morning or afternoon (e.g., when respective shadows of objects in the augmented reality environment are longer), the shadow cast by the respective physical object on the respective virtual user interface object changes accordingly (e.g., the shadow gets smaller/shorter as the time of day changes from morning to mid-day and the shadow gets larger/longer as the time of day changes from mid-day to afternoon). In some embodiments, a 3D virtual model of the respective physical object is used to determine where the shadow of the respective physical object should be in the augmented reality environment. Although in FIGS. **5A21**-**5A24** virtual building model **5012** completely covers physical building model **5006**, if a portion of physical building model **5006** was exposed, that portion of the physical building model **5006** would cast a similar shadow as the time of day is changed in the augmented reality environment. Displaying the physical object with a shadow (e.g., cast on the virtual user interface object) in the augmented reality environment improves the visual feedback provided to the user (e.g., by making the augmented reality environment more realistic and making the computer system appear more responsive to user input as the user changes the virtual environment setting), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0407] In some embodiments, movement of the respective physical object (e.g., as a result of movement in the physical world of the respective physical object and/or as a result of movement of the computer system that causes movement of the respective physical object in the field of view of the one or more cameras) (e.g., movement of user **5002** from a first location (e.g., as shown in FIG. **5A3**) to a second location (e.g., as shown in FIG. **5A5**) causes (**722**) one or more changes in the appearance of the respective virtual user interface object in the augmented reality environment (e.g., changing the view of virtual building model **5012** from a front view to a side view, FIGS. **5A3**-**5A6**). In some embodiments, movement of the respective physical object causes the respective physical object to cast shadows on the respective virtual user interface object differently because as the respective physical object moves, the ambient light source is at a different angle relative to the respective physical object (e.g., as shown in FIGS. **5A3**-**5A6**). Changing the appearance of the virtual user interface object in the augmented reality environment in response to movement of the physical object improves the visual feedback provided to the user (e.g., by making the computer system appear more responsive to user input), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0408] In some embodiments, movement of the computer system causes (**724**) one or more changes in a visual effect that is applied to the representation of at least a portion of the field of view of the one or more cameras (e.g., the live preview) and the appearance of the respective virtual user interface object. For example, if the respective physical object is a physical 3D building model, as the user moves the computer system by walking around to a different side of the physical 3D building model, the angle of the lighting changes, which causes a change in the visual effect that is applied to the live preview and any virtual user interface objects (e.g., shadows, cast by the physical 3D building model and by one or more virtual objects, change) (e.g., as shown in FIGS. **5A3**-**5A6**). Changing the visual effect that is applied to the live preview and changing the appearance of the virtual user interface object in response to movement of the computer system improves the visual feedback provided to the user (e.g., by making the computer system appear more responsive to user input), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0409] In some embodiments, applying the filter to at least a portion of the representation of the field of view of the one or more cameras includes (**726**): applying the filter to an image (or sequence of images) captured by the one or more cameras (e.g., a live preview of at least a portion of the contents that are within the field of view of the one or more cameras) before the image is transmitted to the display generation component (e.g., as shown in FIGS. **5A21**-**5A24**). Applying the filter to the image captured by the cameras before the image is transmitted to the display provides a real-time view of changes made to the virtual environment setting, improves the visual feedback provided to the user (e.g., by making the computer system appear more responsive to user input), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0410] In some embodiments, the input that changes the virtual environment setting is (**728**) an input (e.g., a swipe input or a tap input on a button) (e.g., tap input by contact **5032** on button **5016**, FIG. **5A26**) that switches between different virtual environments for the virtual user interface object, wherein different virtual environments are associated with different interactions for exploring the virtual user interface object (e.g., from a first virtual environment to a second virtual environment) (e.g., as shown in FIGS. **5A25**-**5A27**, from a landscape view to an interior view). In some embodiments, the different virtual environments for the same virtual user interface object are predefined virtual environments (e.g., landscape, interior, and day/night, as shown in FIGS. **5A25**-**5A27**). For example, different virtual environment stories include a historical view, a construction view, a day-in-the-life view, a building exploration view, etc., where a construction view advances through time with a left to right swipe to show different stages of construction of the building, while a building exploration view displays detailed view of the architectural design of the building in response to an upward swipe input. Allowing the user to switch between different virtual environments (e.g., with a swipe input or a tap input on a button) provides an easy and intuitive way for the user to change the virtual environment setting, improves the feedback provided to the user (e.g., by making the computer system appear more responsive to user input), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by reducing the number of steps that are needed to achieve an intended outcome when operating the device and reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0411] In some embodiments, in accordance with a determination that a first virtual environment setting is selected (e.g., a first virtual environment story, such as a construction view), the computer system displays (**730**) a first set of virtual objects in the augmented reality environment; and in accordance with a determination that a second virtual environment setting is selected (e.g., a second virtual environment story, such as a day-in-the-life view), the computer system displays a second set of virtual objects, distinct from the first set of virtual objects, in the augmented reality environment. In some embodiments, different sets of virtual objects are displayed based on the selection of the virtual environment setting. For example, in some embodiments, no trees or people are displayed in the construction view, and trees and people are displayed in the day-in-the-life view. As shown in FIGS. **5**A**25**-**5**A**27**, for example, virtual trees, a virtual person, and a virtual car are displayed in the landscape view (e.g., in FIG. **5**A**25**), and no trees or people or cars are displayed in the interior view (e.g., in FIG. **5**A**27**). Displaying different sets of virtual objects based on the selection of the virtual environment setting improves the feedback provided to the user (e.g., by making the computer system appear more responsive to user input), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by reducing the number of steps that are needed to achieve an intended outcome when operating the device and reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0412] It should be understood that the particular order in which the operations in FIGS. **7**A-**7**C have been described is merely an example and is not intended to indicate that the described order is the only order in which the operations could be performed. One of ordinary skill in the art would recognize various ways to reorder the operations described herein. Additionally, it should be noted that details of other processes described herein with respect to other methods described herein (e.g., methods **600**, **800**, **900**, **1000**, **1100**, **1200**, and **1300**) are also applicable in an analogous manner to method **700** described above with respect to FIGS. **7**A-**7**C. For example, the contacts, gestures, user interface objects, intensity thresholds, focus indicators, and/or animations described above with reference to method **700** optionally have one or more of the characteristics of the contacts, gestures, user interface objects, intensity thresholds, focus indicators, and/or animations described herein with reference to other methods described herein (e.g., methods **600**, **800**, **900**, **1000**, **1100**, **1200**, and **1300**). For brevity, these details are not repeated here.

[0413] FIGS. **8**A-**8**C are flow diagrams illustrating method **800** of transitioning between viewing a virtual model in the augmented reality environment and viewing simulated views of the virtual model from the perspectives of objects in the virtual model, in accordance with some embodiments. Method **800** is performed at a computer system (e.g., portable multifunction device **100**, FIG. **1**A, device **300**, FIG. **3**, or a multi-component computer system including headset **5008** and input device **5010**, FIG. **5**A**2**) having a display generation component (e.g., a display, a projector, a heads-up display, or the like), one or more cameras (e.g., video cameras that continuously provide a live preview of at least a portion of the contents that are within the field of view of the cameras and optionally generate video outputs including one or more streams of image frames capturing the contents within the field of view of the cameras), and an input device (e.g., a touch-sensitive surface, such as a touch-sensitive remote control, or a touch-screen display that also serves as the display generation component, a mouse, a joystick, a wand controller, and/or cameras tracking the position of one or more features of the user such as the user's hands). In some embodiments, the input device (e.g., with a touch-sensitive surface) and the display generation component are integrated into a touch-sensitive display. As described above with respect to FIGS. **3**B-**3**D, in some embodiments, method **800** is performed at a computer system **301** in which respective components, such as a display generation component, one or more cameras, one or more input devices, and optionally one or more attitude sensors are each either included in or in communication with computer system **301**.

[0414] In some embodiments, the display generation component is a touch-screen display and the input device (e.g., with a touch-sensitive surface) is on or integrated with the display generation component. In some embodiments, the display generation component is separate from the input device (e.g., as shown in FIG. **4**B and FIG. **5**A**2**). Some operations in method **800** are, optionally, combined and/or the order of some operations is, optionally, changed.

[0415] For convenience of explanation, some of the embodiments will be discussed with reference to operations performed on a computer system with a touch-sensitive display system **112** (e.g., on device **100** with touch screen **112**). However, analogous operations are, optionally, performed on a computer system (e.g., as shown in FIG. **5**A**2**) with a headset **5008** and a separate input device **5010** with a touch-sensitive surface in response to detecting the contacts on the touch-sensitive surface of the input device **5010** while displaying the user interfaces shown in the figures on the display of headset **5008**.

[0416] As described below, method **800** relates to presenting (on a display of a computer system, such as device **100**, FIG. **5**A**28**) a virtual model (e.g., of a physical object) with virtual user interface objects in an augmented reality environment (e.g., in which reality is augmented with supplemental information that provides the user with additional information that is not available in the physical world) and presenting simulated views of the virtual model (e.g., in a virtual reality environment) from the perspectives of the virtual user interface objects, in response to movement of the computer system and/or detected inputs to the computer system (e.g., a contact on a touch-sensitive surface). In some embodiments, allowing the user to view the virtual model in the augmented reality environment provides the user with access to the supplemental information about the virtual model. In some embodiments, allowing the user to visualize the virtual model from different perspectives in the virtual reality environment provides the user with a more immersive and intuitive way to experience the virtual model. Allowing the user to access supplemental information about a physical object as well as providing an immersive and intuitive viewing experience enhances the operability of the device and makes the user-device interface more efficient (e.g., by reducing user distraction and mistakes when operating/interacting with the device), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0417] The computer system (e.g., device **100**, FIG. **5A28**) displays (**802**), via the display generation component, an augmented reality environment (e.g., the augmented reality environment shown in FIGS. **5A28-5A29**). Displaying the augmented reality environment includes (**804**) concurrently displaying: a representation of at least a portion of a field of view of the one or more cameras that includes a respective physical object (e.g., a 3D model of a building, a sheet of paper with a printed pattern, a poster on a wall or other physical object, a statue sitting on a surface, etc.), wherein the representation is updated as contents of the field of view of the one or more cameras change (e.g., the representation is a live preview of at least a portion of the field of view of the one or more cameras, and the respective physical object is included and visible in the field of view of the cameras); and a first virtual user interface object in a virtual model (e.g., a rendered 3D model of the 3D building model, a virtual 3D model of a building that is placed on a surface represented by the sheet of paper with the printed pattern, a virtual camera affixed to a rendered virtual model of another wall or physical object opposite the wall or physical object with the poster, a virtual person standing near a virtual model (e.g., next to a virtual model of the building, or next to a virtual model of the statue sitting on the surface), etc.) that is displayed at a respective location in the representation of the field of view of the one or more cameras, wherein the first virtual user interface object has a location that is determined based on the respective physical object in the field of view of the one or more cameras. For example, in some embodiments, the first virtual user interface object is a graphical object or a 2D or 3D virtual object that appears to be attached to, or that appears to cover, the respective physical object in the field of view of the one or more cameras. The location and/or orientation of the respective virtual user interface object is determined based on the location, shape, and/or orientation of the physical object in the field of view of the one or more cameras. For example, as described above with reference to FIG. **5A28**, displaying the augmented reality environment includes concurrently displaying: the representation of the portion of the field of view of the cameras, which includes wallpaper **5007** and the edge(s) of table **5004**, as well as physical building model **5006** (as shown in FIG. **5A2**), which is also in the field of view of the cameras; and the first virtual user interface object is virtual vehicle **5050**. While displaying the augmented reality environment (e.g., with the first virtual user interface object overlaid on at least a portion of the field of view of the one or more cameras), the computer system detects (**806**) a first input that corresponds to selection of the first virtual user interface object (e.g., a tap on the first virtual user interface object or a selection of the first virtual user interface object with a cursor, or the like). For example, as described above with reference to FIG. **5A29**, device **100** detects input **5052** that corresponds to selection of vehicle **5050**. In response to detecting the first input (e.g., input **5052**, FIG. **5A29**) that corresponds to selection of the first virtual user interface object (e.g., vehicle **5050**, FIG. **5A29**), the computer system displays (**808**) a simulated field of view of the virtual model from a perspective of the first virtual user interface object in the virtual model (e.g., as shown in and described above with reference to FIG. **5A31**) (and, optionally, ceases to display the representation of the field of view of the one or more cameras, as described herein with reference to operation **810**). For example, when the user selects a virtual car (e.g., vehicle **5050**, FIG. **5A29**) in a rendered 3D model (e.g., the virtual model shown in FIG. **5A29**) of the physical 3D building model (e.g., physical building model **5006**, FIG. **5A1**), the device displays a view of the rendered 3D building model from the perspective of the virtual car (e.g., as if the user were looking at the building model from the perspective of a person within the virtual car (e.g., the driver)). In some embodiments, the computer system also ceases to display the augmented reality environment, including ceasing to display the representation of the field of view of the cameras and the first virtual user interface object. In another example, when tapping on a virtual person standing next to a virtual model of the statue sitting on the surface, the device ceases to display the virtual person, and displays a virtual model of the statue from the perspective of the virtual person standing next to the virtual model of the statue.

[0418] In some embodiments, in response to detecting the first input that corresponds to selection of the first virtual user interface object, the computer system ceases (**810**) to display the representation of the field of view of the one or more cameras (e.g., content in the field of view of the one or more cameras that was displayed prior to detecting the first input as the computer system switches to displaying a view of the virtual model from a perspective of the first virtual object) (e.g., ceasing to display wallpaper **5007** and/or the edge of table **5004**, as described above with reference to FIG. **5A30**). Ceasing to display what is in the field of view of the camera(s) when transitioning to viewing the virtual model from the perspective of the selected virtual user interface object (e.g., in the virtual reality environment) indicates that the user is no longer in AR mode and provides the user with a more immersive viewing experience that allows the user to focus on the virtual model and the virtual environment. Providing the user with a more immersive and intuitive viewing experience of the virtual model enhances the operability of the device and makes the user-device interface more efficient (e.g., by reducing user distraction and mistakes when operating/interacting with the device), which, additional, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently, as well as reduces the energy and processing resources that would be required to capture and simulate the background user interface.

[0419] In some embodiments, in response to detecting movement of at least a portion of the computer system (e.g., movement of one or more components of the computer system, such as the one or more cameras or the input device) that changes the field of view of the one or more cameras while displaying the augmented reality environment, the computer system updates (**812**) the representation of the field of view of the one or more cameras. For example, as described above with reference to FIGS. **5A15**-**5A16**, device **100** changes the field of view of the camera of device **100** in response to movement of device **100**. Updating what is displayed in the augmented reality environment in response to movement that changes the field of view of the camera(s) provides consistency between what is displayed and what a user would expect to see based on the positioning of the computer system (or more specifically, the camera(s)) in the physical world, and thus improves the visual feedback provided to the user (e.g., by making the computer system appear more responsive to user input and camera position/direction). Providing the user with a more intuitive viewing experience enhances the operability of the device and makes the user-device interface more efficient (e.g., by reducing user distraction and mistakes when operating/interacting with the device), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0420] In some embodiments, while displaying the augmented reality environment, in response to detecting movement of at least a portion of the computer system (e.g., movement of a component of the computer system such as the one or more cameras or the input device) that changes a perspective of the contents of the field of view of the one or more cameras, the computer system updates (**814**) the representation of the field of view of the one or more cameras and the virtual model in accordance with the changes in the perspective of the contents of the field of view (e.g., the computer system, using image analysis, determines an updated orientation of the one or more cameras to the physical object, and uses the determined orientation to update the representation). For example, as described above with reference to FIGS. **5A3**-**5A6**, device **100** displays different views of the augmented reality when user **5002** moves from a first position with a first perspective (e.g., from the front of table **5004**, as shown in FIGS. **5A3**-**5A4**) to a second position with a second perspective (e.g., from the side of table **5004**, as shown in FIGS. **5A5**-**5A6**). Updating what is displayed in the augmented reality environment in response to movement that changes the perspective of the camera(s) provides consistency between what is displayed and what a user would expect to see based on the positioning of the computer system (or more specifically, the camera(s)) in the physical world, and improves the visual feedback provided to the user (e.g., by making the computer system appear more responsive to user input and camera position/direction). Providing the user with a more intuitive viewing experience enhances the operability of the device and makes the user-device interface more efficient (e.g., by reducing user distraction and mistakes when operating/interacting with the device), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0421] In some embodiments, in response to detecting the first input that corresponds to selection of the first virtual user interface object, the computer system displays (**816**) an animated transition from the augmented reality environment to the simulated field of view of the virtual model from the perspective of the first virtual user interface object in the virtual model (e.g., an animation from the perspective of a viewer moving (e.g., flying) from an initial position with a view of the augmented reality environment as displayed to the position of the first user interface object in the virtual model with the simulated field of view). For example, as described above with reference to FIGS. **5A29**-**5A31**, device **100** displays an animated transition from the augmented reality environment (FIG. **5A29**) to the simulated field of view of the virtual model from the perspective of vehicle **505** (FIG. **5A31**). Displaying an animated transition (e.g., an animation of flying) between the view of the augmented reality environment and the simulated view of the virtual model from the perspective of the virtual user interface object (e.g., in the virtual reality environment) provides the user with a smoother transition between the views and gives the user the impression of entering the virtual reality environment from the physical world (or the augmented reality environment corresponding to the physical world), while helping the user to maintain context. Providing the user with a more immersive viewing experience with smoother transitions into and out of that viewing experience, and helping the user to maintain context during the viewing experience, enhances the operability of the device and makes the user-device interface more efficient (e.g., by reducing user distraction and mistakes when operating/interacting with the device), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0422] In some embodiments, while displaying the simulated field of view of the virtual model from the perspective of the first virtual user interface object in the virtual model, the computer system detects (**818**) a second input that corresponds to a request to display the augmented reality environment (e.g., a request to exit the virtual reality environment, such as a selection of an affordance for returning to the augmented reality environment, or such as selection of a location in the virtual model that does not have an associated perspective view of the virtual model); and in response to the second input that corresponds to the request to display the augmented reality environment, the computer system: displays an animated transition from the simulated field of view of the virtual model to the augmented reality environment (e.g., an animation from the perspective of a viewer moving (e.g., flying) from the position of the first user interface object in the virtual model with the simulated field of view to a position with a view of the augmented reality environment); and displays the augmented reality environment. For example, as described above with reference to FIGS. **5A37**-**5A40**, while displaying the simulated field of view from the perspective of person **5060** (FIG. **5A37**), device **100** detects input **5066** that corresponds to a request to display the augmented reality environment (FIG. **5A38**), and in response displays the animated transition to the augmented reality environment (FIGS. **5A39**-**5A40**). Displaying an animated transition (e.g., an animation of flying) between the simulated view of the virtual model from the perspective of the virtual user interface object (e.g., in the virtual reality environment) and the view of the augmented reality environment provides the user with a smoother transition between the views and gives the user the impression of exiting the virtual reality environment and returning to the physical world (or the augmented reality environment corresponding to the physical world), while helping the user to maintain context. Providing the user with a more immersive and intuitive viewing experience with smoother transitions into and out of that viewing experience, and helping the user to maintain context during the viewing experience, enhances the operability of the device and makes the user-device interface more efficient (e.g., by reducing user distraction and mistakes when operating/interacting with the device), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0423] In some embodiments, displaying the augmented reality environment in response to the second input comprises (**820**) displaying the augmented reality environment in accordance with the field of view of the one or more cameras subsequent to detecting the second input (e.g., if the field of view of the one or more cameras has changed since detecting the first input, then the displayed augmented reality environment will be shown from a different view in response to the second input). For example, as described above with reference to FIGS. **5A39**-**5A40**, the field of view of the cameras in FIG. **40** has changed from the field of view of the cameras in FIG. **28** when input **5050** (to switch to the simulated perspective view) was detected; accordingly, the augmented reality environment in FIG. **40** is shown from a different view in response to input **5066** (to return to the view of the augmented reality environment). Updating what is displayed in the augmented reality environment when returning to the augmented reality environment from the virtual reality environment provides consistency between what is displayed and what a user would expect to see based on the positioning of the computer system (or more specifically, the camera(s)) in the physical world at the time the user is returned to the augmented reality view, and thus improves the visual feedback provided to the user (e.g., by making the computer system appear more responsive to user input and camera position/direction). Providing the user with a more intuitive viewing experience enhances the operability of the device and makes the user-device interface more efficient (e.g., by reducing user distraction and mistakes when operating/interacting with the device), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0424] In some embodiments, the field of view of the one or more cameras subsequent to detecting the second input is (**822**) different from the field of view of the one or more cameras when the first input was detected (e.g., the field of view of the one or more cameras has changed from the field of view that was displayed (or of which a representation was displayed) immediately prior to switching to the virtual reality environment, as described herein with reference to FIGS. **5A28** and **5A40**, and operation **820**). Updating what is displayed in the augmented reality environment when returning to the augmented reality environment from the virtual reality environment provides consistency between what is displayed and what a user would expect to see based on the positioning of the computer system (or more specifically, the camera(s)) in the physical world at the time the user is returned to the augmented reality view. In particular, if the field of view of the camera(s) upon returning to the augmented reality environment is different from the previous field of view of the camera(s) just before the user left the augmented reality environment and entered the virtual reality environment, then the user might naturally expect to see a different field of view displayed upon returning to the augmented reality environment. As such, presenting a different view of the augmented reality environment upon returning improves the visual feedback provided to the user (e.g., by making the computer system appear more responsive to user input and camera position/direction). Providing the user with a more intuitive viewing experience enhances the operability of the device and makes the user-device interface more efficient (e.g., by reducing user distraction and mistakes when operating/interacting with the device), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0425] In some embodiments, the first virtual user interface object moves (**824**) in the virtual model independently of inputs from a user of the computer system. In some embodiments, the first virtual user interface object moves independently in the augmented reality environment. For example, when a virtual person walks around in the virtual model autonomously (e.g., in the augmented reality environment); the user of the computer system has no control over the movement of the virtual person in the virtual model (e.g., as described herein with reference to FIG. **5A31**). Displaying movement of the virtual user interface object in the virtual model independent of user inputs (e.g., in the augmented reality environment) presents the user with a more intuitive viewing experience in which virtual user interface objects appear to move autonomously within the augmented reality environment. Providing the user with a more intuitive viewing experience enhances the operability of the device and makes the user-device interface more efficient (e.g., by reducing user distraction and mistakes when operating/interacting with the device), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0426] In some embodiments, while displaying the simulated field of view of the virtual model from the perspective of the first virtual user interface object in the virtual model, the first virtual user interface object moves (**826**) in the virtual model in response to one or more inputs from a user of the computer system. In some embodiments, while viewing the virtual model from the perspective of a virtual person or virtual vehicle in the virtual model, the user controls the movement of the virtual person or vehicle (e.g., a direction and/or speed of movement) in the virtual model. For example, a user may control where the virtual person walks (e.g., as described herein with reference to FIG. **5A35**-**5A37**), or where the virtual vehicle drives (e.g., as described herein with reference to FIG. **5A31**-**5A33**), within the environment of the virtual model. Allowing the user to move the virtual user interface object in the virtual model (e.g., in the virtual reality environment) provides the user with a more immersive viewing experience that allows the user to access additional information about the virtual model as if the user were present in the virtual model, and improves the visual feedback provided to the user (e.g., by making the computer system appear more responsive to user input). Providing the user with a more immersive viewing experience and improved visual feedback enhances the operability of the device and makes the user-device interface more efficient (e.g., by reducing user distraction and mistakes when operating/interacting with the device), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0427] In some embodiments, while displaying the simulated field of view, the computer system detects (**828**) movement of at least a portion of the computer system (e.g., movement of one or more components of the computer system, such as the one or more cameras or the input device), and, in response to detecting the movement of the computer system, changes the simulated field of view of the virtual model from the perspective of the first virtual user interface object in accordance with the movement of the computer system. In some embodiments, the simulated field of view in the virtual reality environment is updated in accordance with changes in attitude (e.g., orientation and/or position) of the computer system, or of one or more components of the computer system. For example, if a user raises the computer system upward, the simulated field of view is updated as if the virtual person in the virtual model lifted their head to look upward. Changes in attitude of the computer system are, optionally, determined based on a gyroscope, magnetometer, inertial measurement unit, and/or one or more cameras of the device that detect movement of the device based on objects in the field of view of the one or more cameras. For example, as described above with reference to FIGS. **5A35**-**5A37**, in response to movement of device **100** toward the left and rotation of device **100**, the displayed simulated perspective view of the virtual model, from the perspective of person **5060**, is updated. Changing what is displayed in the virtual reality environment from the perspective of the virtual user interface object in response to movement of the computer system provides the user with a more immersive viewing experience that allows the user to access additional information about the virtual model as if the user were present in the virtual model, and improves the visual feedback provided to the user (e.g., by making the computer system appear more responsive to user input). Providing the user with a more immersive viewing experience and improved visual feedback enhances the operability of the device and makes the user-device interface more efficient (e.g., by reducing user distraction and mistakes when operating/interacting with the device), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0428] In some embodiments, while displaying the simulated field of view of the virtual model from the perspective of the first virtual user interface object in the virtual model (e.g., the simulated view from the perspective of vehicle **5050** as shown in FIG. **5A33**), the computer system detects (**830**) a third input (e.g., input **5062**, FIG. **5A34**) that corresponds to selection of a second virtual user interface object in the virtual model (e.g., a virtual person or virtual vehicle in the virtual model) (e.g., person **5060**, FIG. **5A34**); and in response to detecting the third input that corresponds to selection of the second virtual user interface object, displays a second simulated field of view of the virtual model from a perspective of the second virtual user interface object in the virtual model (e.g., the simulated view from the perspective of person **5060** as shown in FIG. **5A35**) (e.g., and ceases to display the simulated field of view of the virtual model from the perspective of the first virtual user interface object in the virtual model). Allowing the user to view the virtual model from the perspective of multiple virtual user interface objects in the virtual model, and allowing the user to switch between the various perspective views by selecting the corresponding virtual user interface object for that view, provides the user with a more immersive viewing experience that allows the user to access additional information about the virtual model from multiple perspectives as if the user were present in the virtual model, and improves the visual feedback provided to the user (e.g., by making the computer system appear more responsive to user input). Providing the user with a more immersive viewing experience and improved visual feedback enhances the operability of the device and makes the user-device interface more efficient (e.g., by reducing user distraction and mistakes when operating/interacting with the device), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0429] In some embodiments, while displaying the simulated field of view of the virtual model from the perspective of the first virtual user interface object in the virtual model (e.g., the simulated view from the perspective of person **5060** as shown in FIG. **5A37**), the computer system detects (**832**) a fourth input that corresponds to a selection of a location in the virtual model other than a virtual user interface object for which an associated simulated field of view can be displayed (e.g., as described herein with reference to input **5066**, FIG. **5A38**); and, in response to detecting the fourth input, redisplays the augmented reality environment (e.g., the view of the augmented reality environment as shown in FIG. **5A40**) (e.g., and ceases to display the simulated field of view of the virtual model from the perspective of the first virtual user interface object in the virtual model). In some embodiments, some virtual user interface objects in the virtual model are ones for which simulated fields of view can be displayed from the perspective of those objects. In some embodiments, other locations in the virtual model, including some virtual user interface objects, do not have associated simulated fields of view, or do not allow display of a simulated field of view from their perspectives, and, in some embodiments, a user can select such locations or objects to exit the virtual reality environment and redisplay the augmented reality environment. For example, while selection of a virtual person results in display of a simulated field of view from the perspective of the virtual person, selection of a patch of grass results in exit of the virtual reality environment and redisplay of the augmented reality environment. In some embodiments, the device redisplays the augmented reality environment and ceases to display the simulated field of view of the virtual model from the perspective of the first virtual user interface object in the virtual model in response to selection of an "exit" button or affordance or in response to a gesture such as an edge swipe gesture that starts from an edge of the touch-sensitive surface or a pinch gesture that includes movement of two or more contacts toward each other by at least a predetermined amount. Allowing the user to return from the virtual reality environment to the augmented reality environment by selecting a location in the virtual model for which a corresponding perspective view is not displayed provides the user with an intuitive and straightforward way to transition back to the augmented reality environment without requiring more inputs or additional displayed controls. Reducing the number of inputs needed to perform an operation and providing additional control options without cluttering the user interface with additional displayed controls enhances the operability of the device and makes the user-device interface more efficient (e.g., by reducing user distraction and mistakes when operating/interacting with the device), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0430] It should be understood that the particular order in which the operations in FIGS. **8**A-**8**C have been described is merely an example and is not intended to indicate that the described order is the only order in which the operations could be performed. One of ordinary skill in the art would recognize various ways to reorder the operations described herein. Additionally, it should be noted that details of other processes described herein with respect to other methods described herein (e.g., methods **600**, **700**, **900**, **1000**, **1100**, **1200**, and **1300**) are also applicable in an analogous manner to method **800** described above with respect to FIGS. **8**A-**8**C. For example, the contacts, gestures, user interface objects, intensity thresholds, focus indicators, and/or animations described above with reference to method **800** optionally have one or more of the characteristics of the contacts, gestures, user interface objects, intensity thresholds, focus indicators, and/or animations described herein with reference to other methods described herein (e.g., methods **600**, **700**, **900**, **1000**, **1100**, **1200**, and **1300**). For brevity, these details are not repeated here.

[0431] FIGS. **9**A-**9**E are flow diagrams illustrating method **900** of three-dimensional manipulation of virtual user interface objects, in accordance with some embodiments. Method **900** is performed at a computer system (e.g., portable multifunction device **100**, FIG. **1**A, device **300**, FIG. **3**A, or a multi-component computer system including headset **5008** and input device **5010**, FIG. **5**A**2**) that includes (and/or is in communication with) a display generation component (e.g., a display, a projector, a heads-up display, or the like) and an input device (e.g., a touch-sensitive surface, such as a touch-sensitive remote control, or a touch-screen display that also serves as the display generation component, a mouse, a joystick, a wand controller, and/or cameras tracking the position of one or more features of the user such as the user's hands), optionally one or more cameras (e.g., video cameras that continuously provide a live preview of at least a portion of the contents that are within the field of view of the cameras and optionally generate video outputs including one or more streams of image frames capturing the contents within the field of view of the cameras), optionally one or more attitude sensors, optionally one or more sensors to detect intensities of contacts with the touch-sensitive surface, and optionally one or more tactile output generators. In some embodiments, the input device (e.g., with a touch-sensitive surface) and the display generation component are integrated into a touch-sensitive display. As described above with respect to FIGS. **3**B-**3**D, in some embodiments, method **900** is performed at a computer system **301** (e.g., computer system **301**-*a*, **301**-*b*, or **301**-*c*) in which respective components, such as a display generation component, one or more cameras, one or more input devices, and optionally one or more attitude sensors are each either included in or in communication with computer system **301**.

[0432] In some embodiments, the display generation component is a touch-screen display and the input device (e.g., with a touch-sensitive surface) is on or integrated with the display generation component. In some embodiments, the display generation component is separate from the input device (e.g., as shown in FIG. **4**B and FIG. **5**A**2**). Some operations in method **900** are, optionally, combined and/or the order of some operations is, optionally, changed.

[0433] For convenience of explanation, some of the embodiments will be discussed with reference to operations performed on a computer system with a touch-sensitive display system **112** (e.g., on device **100** with touch screen **112**) and one or more integrated cameras. However, analogous operations are, optionally, performed on a computer system (e.g., as shown in FIG. **5**A**2**) with a headset **5008** and a separate input device **5010** with a touch-sensitive surface in response to detecting the contacts on the touch-sensitive surface of the input device **5010** while displaying the user interfaces shown in the figures on the display of headset **5008**. Similarly, analogous operations are, optionally, performed on a computer system having one or more cameras that are implemented separately (e.g., in a headset) from one or more other components (e.g., an input device) of the computer system; and in some such embodiments, "movement of the computer system" corresponds to movement of one or more cameras of the computer system, or movement of one or more cameras in communication with the computer system.

[0434] As described below, method **900** relates to adjusting (on a display of a computer system) an appearance of a virtual user interface object, also referred to herein as a virtual object, in an augmented reality environment (e.g., in which reality is augmented with supplemental information that provides additional information to the user that is not available in the physical world), based on selection of a portion of the virtual user interface object and movement of an input in two dimensions. Adjusting an appearance of a virtual user interface object (e.g., moving the virtual user interface object or adjusting the size of the virtual user interface object) based on selection of a portion of the virtual user interface object and movement of an input in two dimensions provides an intuitive way for the user to adjust the appearance of the virtual user interface object (e.g., via movement of a contact on the input device or movement of a remote control), thereby enhancing the operability of the device and making the user-device interface more efficient (e.g., by allowing the user to interact with the virtual user interface object directly rather than cluttering the displayed user interface with additional controls), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0435] The computer system (e.g., device **100**, FIG. **5**B**2**) displays (**902**), via the display generation component (e.g., display **112**, FIG. **5**B**2**), a first virtual user interface object (e.g., user interface object **5210**, FIG. **5**B**2**) in a virtual three-dimensional space. For example, in some embodiments, the first virtual user interface object is a 2D or 3D virtual object that appears to be attached to, or cover, a physical object (e.g., reference mat **5208***a*, FIG. **5**B**2**) in the field of view of one or more cameras that are coupled to the computer system. The location and/or orientation of the first virtual user interface object **5210** is optionally determined based on the location, shape, and/or orientation of the physical object **5208***a* in the field of view of the one or more cameras.

[0436] While displaying the first virtual user interface object **5210** in the virtual three-dimensional space (**904**), the computer system detects, via the input device, a first input that includes selection of a respective portion of the first virtual user interface object **5210** and movement of the first input in two dimensions (e.g., movement of a contact across a planar touch-sensitive surface, or movement of a remote control that include movement components in two orthogonal dimensions of the three dimensional physical space around the remote control).

[0437] For example, as illustrated in FIG. **5**B**6**, an input by contact **5222** selects the top surface of virtual user interface object **5210** (as indicated by movement projections **5226** that indicate the plane of movement of virtual box **5210**) and the contact **5222** moves in two dimensions across touch-sensitive surface **112**, as indicated by arrow **5228**.

[0438] In another example, illustrated in FIG. **5**B **10**, an input by contact **5232** selects the front surface of virtual user interface object **5210** (as indicated by movement projections **5236**) and the contact **5232** moves in two dimensions across touch-sensitive surface **112**, as indicated by arrow **5238**.

[0439] In another example, illustrated in FIGS. **5**B**18**-**5**B**20**, an input by contact **5244** selects the top surface of virtual user interface object **5210** (as indicated by resizing projections **5246** that indicate an axis along which virtual box **5210** will be resized in response to subsequent movement of the contact) and the contact **5244** moves in two dimensions across touch-sensitive surface **112**, as indicated by arrow **5248**.

[0440] In another example, illustrated in FIGS. **5**B**28**-**5**B**30**, an input by contact **5262** selects the front surface of virtual user interface object **5260** (as indicated by resizing projections **5266** that indicate an axis along which virtual box **5260** will be resized) and the device **100** moves in two dimensions, as indicated by arrow **5268**.

[0441] In response to detecting the first input that includes movement of the first input in two dimensions (**906**): in accordance with a determination that the respective portion of the first virtual user interface object is a first portion of the first virtual user interface object (e.g., a first side of a cubical object, such as the top side of virtual user interface object **5210** as indicated in FIG. **5**B**6**), the computer system adjusts an appearance of the first virtual user interface object (e.g., by resizing, translating, and/or skewing) in a first direction determined based on the movement of the first input in two dimensions (e.g., as indicated by arrow **5228**, FIG. **5**B**6**) and the first portion of the first virtual user interface object that was selected. The adjustment of the first virtual user interface object in the first direction is constrained to movement in a first set of two dimensions of the virtual three-dimensional space (e.g., as indicated by movement projections **5226**). In accordance with a determination that the respective portion of the first virtual user interface object **5210** is a second portion of the first virtual user interface object that is distinct from the first portion of the first virtual user interface object (e.g., a second side of the cubical object that is next to or opposite to the first side of the cubical object, such as the front side of virtual user interface object **5210** as indicated in FIG. **5**B **10**), the computer system adjusts the appearance of the first virtual user interface object (e.g., by resizing, translating, and/or skewing) in a second direction that is different from the first direction. The second direction is determined based on the movement of the first input in two dimensions (e.g., as indicated by arrow **5238**, FIG. **5**B **10**) and the second portion of the first virtual user interface object that was selected. The adjustment of the first virtual user interface object **5210** in the second direction is constrained to movement in a second set of two dimensions of the virtual three-dimensional space (e.g., as indicated by movement projections **5236**) that is different from the first set of two dimensions of the virtual three-dimensional space. For example, an amount of adjustment that is made to the appearance of the first virtual user interface object **5210** in a respective direction of the first direction and the second direction is constrained in at least one dimension of virtual three-dimensional space (e.g., as indicated by movement projections) that is selected in accordance with the respective portion of the first virtual user interface object that was selected. In some embodiments, the movement of the cubical object in the virtual three-dimensional space is constrained to the plane of the selected side of the cubical object (e.g., as illustrated by FIGS. **5**B**6**-**5**B**8** and **5**B **10**-**5**B**11**). In some embodiments, the extrusion of the cubical object is constrained within the direction that is perpendicular to the plane of the selected side of the cubical object (e.g., as illustrated in FIGS. **5**B **19**-**5**B**20** and FIGS. **5**B**29**-**5**B**30**). In some embodiments, while the first virtual user interface object is selected, a visual indication of selection of the first virtual user interface object is displayed. For example, one or more lines along edges of first virtual user interface object are highlighted (e.g., as illustrated by movement projections **5226** and **5236**) and/or the first virtual user interface object is highlighted. In some embodiments, the computer system detects a plurality of inputs that include selection of a respective portion of the first virtual user interface object and movement of the first input in two dimensions, wherein the plurality of inputs includes at least one input for which the respective portion of the first virtual user interface object is the first portion of the first virtual user interface object, and at least one input for which the respective portion of the first virtual user interface object is the second portion of the first virtual user interface object.

[0442] In some embodiments, the first portion is (**908**) a first side (e.g., top side **5224**, FIG. **5**B**6**) of the first virtual user interface object, the second portion is a second side (e.g., front side **5234**, FIG. **5**B **10**) of the first virtual user interface object, and the first side is not parallel to the second side (e.g., the first side is perpendicular to the second side). Adjusting the appearance of the virtual user interface differently depending on whether the selected portion of the virtual user interface object is a first side of the object or a second side of the object (that is not parallel to the first side of the object) provides an intuitive way for the user to adjust the appearance of the first virtual user interface object (e.g., by allowing the user to adjust the appearance of the first virtual user interface object in a particular plane or along a particular axis). Allowing the user to adjust the first virtual user interface object (e.g., via direct interaction with a selected portion of the first virtual user interface object) avoids cluttering the user interface with additional displayed controls, thereby enhancing the operability of the device and making the user-device interface more efficient, which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0443] In some embodiments, adjusting the appearance of the first virtual user interface object includes (**910**) adjusting the appearance of the first virtual user interface object (e.g., moving or resizing the first virtual user interface object) such that a position of the first virtual user interface object is locked to a plane that is parallel to the selected respective portion of the virtual user interface object (e.g., by locking a position of the first virtual user interface object is to a plane that is parallel to the selected respective portion of the virtual user interface object). For example, in FIGS. **5**B**6**-**5**B**8**, the position of virtual user interface object **5210** is locked to a plane, indicated by movement projections **5226**, that is parallel to selected top side **5224** of virtual user interface object **5210**. In some embodiments, the parallel plane is perpendicular to a line that is normal to the surface of the selected respective portion and is in contact with that surface. The two-dimensional movement of the first input corresponds to two-dimensional movement of the first virtual user interface object on the plane that is parallel to the selected respective portion of the virtual user interface object (e.g., by mapping the two-dimensional movement of the first input to two-dimensional movement of the first virtual user interface object on the plane that is parallel to the selected respective portion of the virtual user interface object). For example, movement of input by contact **5222**, as indicated by arrows **5228** and **5230**, causes virtual object **5210** to move on the plane indicated by movement projections **5226**. In some embodiments, adjusting the appearance of the first virtual interface object in the first direction includes adjusting the appearance of the first virtual interface object along a first plane (e.g., and adjusting in the second direction includes adjusting along a second plane that is not parallel (e.g., perpendicular to) the first plane). For example, in FIGS. **5**B**6**-**5**B**8**, virtual user interface object **5210** is moved along a first plane, as illustrated by movement projections **5226**, and in FIGS. **5**B **10**-**5**B **11**, virtual user interface object **5210** is moved along a second plane, as illustrated by movement projections **5236**. Adjusting the appearance of the first virtual user interface object such that the position of the first virtual user interface object is locked to a plane that is parallel to the selected respective portion of the virtual user interface, and such that movement of the first virtual user interface object is on the plane, enable an object to be manipulated in a three-dimensional space using inputs on a two-dimensional surface (e.g., touch-sensitive surface **112**). Enabling an object to be manipulated in three-dimensional space using inputs on a two-dimensional surface provides an intuitive way for a user to adjust the appearance of the first virtual user interface object (e.g., by confining movement of the first virtual user interface object to a plane, such that the user can predict and understand how the appearance of the first virtual user interface object will be adjusted in response to input in two dimensions), thereby enhancing the operability of the device and making the user-device interface more efficient, which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0444] In some embodiments, adjusting the appearance of the first virtual user interface object includes (**912**) displaying (e.g., while the first input is detected) a plane-of-movement indicator (e.g., one or more lines that extend from edges of the object (such as movement projections **5226**), a shape outline displayed in the plane, and/or a grid displayed in the plane) that includes a visual indication of the plane that is parallel to the selected respective portion of the virtual user interface object. Displaying a visual indication of the plane that is parallel to the selected respective portion of the virtual user interface object improves the visual feedback provided to the user (e.g., by providing an indication of how the appearance of the first virtual user interface object will be adjusted in response to input in two dimensions), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by helping the user to achieve an intended outcome with the required inputs and reducing user mistakes when operating/interacting with the device), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0445] In some embodiments, the plane-of-movement indicator includes (**914**) one or more projections (e.g., lines) that extend from the first virtual user interface object (e.g., from a surface and/or side of the first virtual user interface object) along the plane that is parallel to the selected respective portion of the virtual user interface object (such as movement projections **5226**). Displaying projections that extend from the first virtual user interface object (e.g., to indicate the plane along which the first virtual user interface object will move in response to input in two dimensions) enhances the operability of the device and makes the user-device interface more efficient (e.g., by helping the user to achieve an intended outcome with the required inputs and reducing user mistakes when operating/interacting with the device), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0446] In some embodiments, in response to detecting the first input that includes movement of the first input, the computer system determines (**916**) whether the first input meets size adjustment criteria. In some embodiments, determining whether the first input meets size adjustment criteria includes determining whether the first input has a duration that increases above a duration threshold (e.g., the first input is a long press input). In some embodiments, the computer system includes one or more sensors configured to detect intensities of contacts with a touch-sensitive surface and determining whether the first input meets size adjustment criteria includes determining whether the first input has a characteristic intensity (e.g., as described with regard to FIGS. **4**D-**4**E) that increases above an intensity threshold (e.g., light press intensity threshold IT_L and/or deep press intensity threshold IT_D). In accordance with a determination that the first input meets the size adjustment criteria, the computer system adjusts the appearance of the first virtual user interface object such that a position of the first virtual user interface object is locked to an anchor point in the virtual three-dimensional space (e.g., a position of the first virtual user interface object is locked to an anchor point in the virtual three-dimensional space) and a size of the first virtual user interface object is adjusted along an axis that is perpendicular to the selected respective portion (e.g., the axis is normal to the surface of the selected respective portion (or a centroid of the selected respective portion) of the first virtual user interface object. For example, in FIGS. **5**B **18**-**5**B **19**, in accordance with a determination that an input by contact **5244** meets duration criteria, it is determined that the input meets size adjustment criteria (e.g., as indicated by display of resizing projections **5246** that are perpendicular to the top side **5224** of virtual user interface object **5210** that is selected by contact **5244**) and, in FIGS. 5B **19**-5B**20**, the size of virtual user interface object **5210** is adjusted along the axis indicated by resizing projections **5246**. Allowing the user to adjust the size of the virtual user interface object in response to an input that includes movement of the input in two dimensions provides an intuitive way for the user to adjust the size of the virtual user interface object, improves the feedback provided to the user (e.g., by making the computer system appear more responsive to user input), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by helping the user to achieve an intended outcome with the required inputs and reducing user mistakes when operating/interacting with the device), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0447] In some embodiments, the anchor point is (**918**) located on a portion of the first virtual user interface object that is opposite to the selected respective portion of the first virtual user interface object (e.g., the anchor point is located on a side of the first virtual user interface object that is opposite to a selected side of the virtual user interface object). For example, in FIG. 5B**19**, the selected side of virtual user interface object **5210** is top side **5224** (e.g., as indicated by display of resizing projections **5246** that are perpendicular to the top side **5224**) and the anchor point is located on the side of virtual user interface object **5210** that is opposite top side **5224** (e.g., the side of virtual user interface object **5210** that is adjacent to displayed version **5208***b* of reference mat **5208**). In some embodiments, the anchor point is located on the selected respective portion of the virtual user interface object. Anchoring the portion of the first virtual user interface object to a point on a portion of the first virtual user interface object that is opposite to the selected portion provides an intuitive way for the user to adjust the appearance of the virtual user interface object (e.g., by giving the user a sense of extending the object by pulling outward from the selected surface, particularly when the first virtual user interface object is shown relative to a plane), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by helping the user to achieve an intended outcome with the required inputs and reducing user mistakes when operating/interacting with the device), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0448] In some embodiments, the anchor point is (**920**) a centroid of the first virtual user interface object (e.g., a centroid of the first virtual user interface object at the time that the position of the first virtual user interface object becomes locked). For example, the anchor point is a centroid of virtual user interface object **5210**. Anchoring the portion of the first virtual user interface object to a point at a centroid of the first virtual user interface object that is opposite to the selected portion provides an intuitive way for the user to adjust the appearance of the virtual user interface object (e.g., by giving the user a sense of extending the object by pulling outward from the selected surface, particularly when the first virtual user interface object is suspended in space), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by helping the user to achieve an intended outcome with the required inputs and reducing user mistakes when operating/interacting with the device), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0449] In some embodiments, adjusting the appearance of the first virtual user interface object includes (**922**) displaying (e.g., while the first input is detected) an axis-of-movement indicator, wherein the axis-of-movement indicator includes a visual indication (e.g., one or more lines that extend from edges of the object, a shape outline displayed in the plane, and/or a grid displayed in the plane) of an axis that is perpendicular to the selected respective portion of the first virtual user interface object. For example, an axis-of movement indicator includes resizing projections **5246** that are perpendicular to the top side **5224** of virtual user interface object selected by contact **5244** in FIG. **5**B **19**. Displaying an axis-of-movement indicator of an axis that is perpendicular to the selected respective portion of the first virtual user interface object improves the visual feedback provided to the user (e.g., by providing an indication of how the appearance of the first virtual user interface object will be adjusted in response to input in two dimensions), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by helping the user to achieve an intended outcome with the required inputs and reducing user mistakes when operating/interacting with the device), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0450] In some embodiments, the axis-of-movement indicator includes (**924**) one or more projections (e.g., resizing projections **5246**, FIG. **5**B **19**) parallel to the axis that is perpendicular to the respective portion of the first virtual user interface object (e.g., top side **5224** of virtual user interface object **5210**), wherein the one or more projections extend from (a surface and/or side of) the first virtual user interface object. Displaying projections that extend from the first virtual user interface object improves the visual feedback provided to the user (e.g., by showing, using indicators placed relative to the first virtual user interface object, how input will change the appearance of the first virtual user interface object), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by helping the user to achieve an intended outcome with the required inputs and reducing user mistakes when operating/interacting with the device), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0451] In some embodiments, the computer system includes (**926**) one or more tactile output generators **163** for generating tactile outputs. While adjusting an appearance of the first virtual user interface object in a respective direction, the computer system determines that the movement of the first input causes a respective portion of the first virtual user interface object to collide with a virtual element that exists in the virtual three-dimensional space (e.g., a virtual element that is displayed or not displayed in the virtual three-dimensional space, such as another virtual user interface object and/or a virtual grid line, such as a grid line of displayed version **5208***b* of reference mat **5208**). In accordance with the determination that the movement of the first input causes the respective portion of the first virtual user interface object to collide with the virtual element, the computer system generates, with the one or more tactile output generators **163**, a tactile output. Generating a tactile output in accordance with a determination that a portion of the first virtual user interface object has been caused to collide with a virtual element improves the feedback provided to the user (e.g., by indicating a distance and direction that the first virtual user interface object has moved (as the first virtual user interface object moves across virtual grid lines) and/or by giving the user an intuitive understanding of the relative positions of the virtual user interface object and the virtual elements in its environment). This enhances the operability of the device, and makes the user-device interface more efficient (e.g., by helping the user to move the object to a desired location), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0452] In some embodiments, while displaying the virtual three-dimensional space (**928**) (e.g., prior to creation and/or display of the first virtual user interface object in the virtual three-dimensional space), the computer system detects, via the input device, a second input that is directed to a first location in the virtual three-dimensional space (e.g., a location that corresponds to a respective portion of the first virtual user interface object or a location that does not correspond to the first virtual user interface object). For example, an input by contact **5254** is detected, as indicated in FIG. **5**B**24**. In response to detecting the second input, in accordance with a determination that the second input has a first input type (e.g., the second input is a tap input), the computer system displays, at the first location in the virtual three-dimensional space, an insertion cursor (e.g., insertion cursor **5256**, FIG. **5**B**25**). While the insertion cursor is displayed at the first location, the computer system detects, via the input device, a third input (e.g., as indicated by contact **5258**, FIG. **5**B**26**). In response to detecting the third input, the computer system, in accordance with a determination that the third input has the first input type (e.g., the third input is a tap input) and is directed to the first location that corresponds to the displayed insertion cursor, inserts a second virtual user interface object (e.g., virtual user interface object **5260**, FIG. **5**B**26**) at the first location. In accordance with a determination that the third input has the first input type and is directed to a second location that does not correspond to the displayed insertion cursor (e.g., as shown in FIG. **5**B**22**-**5**B**25**), the computer system displays the insertion cursor at the second location. For example, in FIG. **5**B**22**, an input by contact **5250** causes an insertion cursor **5252** to be placed at a location that corresponds to the location of contact **5250**, as indicated in FIG. **5**B**23**. A subsequent input by contact **5254** is detected at a location that does not correspond to the location of insertion cursor **5252**. Because the location of contact **5254** does not correspond to the location of insertion cursor **5252**, in FIG. **5**B**25**, an insertion cursor **5256** is displayed at a location that corresponds to the location of contact **5254** (and no new virtual user interface object is generated in response to the input by contact **5254**). In some embodiments, the computer system detects a plurality of inputs, wherein the plurality of inputs includes at least one input that has the first input type and that is directed to a first location that corresponds to a displayed insertion cursor, and at least one input that has the first input type and that is directed to a second location that does not correspond to a displayed insertion cursor. Determining whether to insert a new virtual user interface object or move the insertion cursor, depending on whether the location of an input of the first type corresponds to a location of a displayed insertion cursor or to a location that does not include the displayed insertion cursor, enables the performance of multiple different types of operations with the first type of input. Enabling the performance of multiple different types of operations with the first type of input increases the efficiency with which the user is able to perform these operations, thereby enhancing the operability of the device, which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0453] In some embodiments, while displaying the virtual three-dimensional space (**930**), the computer system detects, via the input device, a fourth input that is directed to a third location in the virtual three-dimensional space (e.g., an input by contact **5270**, as shown in FIG. **5**B**32**). In response to detecting the fourth input that is directed to the third location in the virtual three-dimensional space, in accordance with a determination that the fourth input has the first input type (e.g., the fourth input is a tap input), the computer system displays an insertion cursor (e.g., insertion cursor **5272**, FIG. **5**B**33**) at the third location (e.g., moves an existing insertion cursor from a second location to the respective location, or displays a new insertion cursor at the respective location if no insertion cursor was displayed in the simulated environment prior to the first input). While the insertion cursor is displayed at the third location, the computer system detects, via the input device, a fifth input (e.g., an input by contact **5276**, FIG. **5**B**34**) at a location that corresponds to a new object control (e.g., new object control **5216**) that, when activated, causes insertion of a new virtual user interface object at the third location. In response to detecting the fifth input, the computer system inserts the new virtual user interface object (e.g., virtual user interface object **5276**, FIG. **5**B**36**) at the third location. Providing a new object control that, when activated, causes insertion of a new virtual user interface object at a location of an insertion cursor increases the efficiency with which a user is able to create new virtual user interface objects (e.g., by allowing the user to insert a series of new virtual user interface objects by providing repeated inputs at the location of the new object control). Increasing the efficiency with which a user is able to create new virtual user interface objects enhances the operability of the device and makes the user-device interface more efficient, which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0454] In some embodiments, the computer system detects (**932**), via the input device, a gesture that corresponds to an interaction with the virtual three-dimensional space (e.g., a pinch or swipe gesture on the touch-sensitive surface). For example, FIGS. **5**B**36**-**5**B**37** illustrate a pinch gesture by contacts **5278** and **5280**. In response to detecting the gesture that corresponds to the interaction with the virtual three-dimensional space, the computer system performs an operation in the virtual three-dimensional space that corresponds to the gesture (e.g., zooming, rotating, moving an object, etc.). For example, in response to the pinch gesture illustrated in FIGS. **5**B**36**-**5**B**37**, a zoom operation is performed (e.g., virtual user interface object **5210**, **5260**, and **5276** are reduced in size as the zoom out operation occurs). Performing an operation in virtual three-dimensional space in response to a gesture, such as a pinch or a swipe, that interacts with the virtual three-dimensional space provides an efficient and intuitive way for the user to control the virtual three-dimensional space (e.g., by allowing the user to adjust a view of the virtual three-dimensional space using a single input with motion, such as a pinch or swipe, that corresponds to adjustment of the virtual three-dimensional space). Providing the user with gesture-based control of the virtual three-dimensional space avoids cluttering the user interface with additional displayed controls, thereby enhancing the operability of the device and making the user-device interface more efficient, which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0455] In some embodiments, the computer system includes (**934**) one or more cameras, and the displayed virtual three-dimensional space includes one or more physical objects (e.g., reference mat **5208***a*, FIG. **5**B**2**) that are in a field of view of the one or more cameras and one or more virtual three-dimensional models of the one or more physical objects that are in the field of view of the one or more cameras (e.g., displayed version **5208***b* of reference mat **5208***a*). Displaying a virtual three-dimensional model of a physical object provides a frame of reference in the physical world for the displayed virtual three-dimensional space. Providing this frame of reference allows the user to change a view of virtual objects in the virtual three-dimensional space by manipulating a physical object (such as a reference mat, e.g., by rotating the reference mat), thereby providing an intuitive way for the user to adjust a view of the first virtual user interface object, enhancing the operability of the device and making the user-device interface more efficient, which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0456] In some embodiments, the appearance of the first virtual user interface object is (**936**) adjusted in response to detecting the movement of the first input relative to a respective physical object in the field of view of the one or more cameras without regard to whether the movement of the first input is due to: movement of the first input on the input device (e.g., movement of a contact across the touch-screen display or across the touch-sensitive surface of the input device while the input device is held substantially stationary in physical space), movement of the one or more cameras relative to the respective physical object (e.g., movement of the computer system including the cameras in the physical space while the contact is maintained and kept stationary on the touch-screen display or touch-sensitive surface of the input device), or a combination of the movement of the first input on the input device and the movement of the one or more cameras relative to the respective physical object (e.g., concurrent movement of the contact across the touch-screen display or touch-sensitive surface of the input device and movement of the computer system including the cameras in the physical space). For example, as shown in FIGS. **5**B**29**-**5**B**30**, device **100** (e.g., a computing device that includes one or more cameras) is moved relative to the reference mat **5208***a* while contact **5262** is maintained and kept stationary on the touch-screen display **112**. In response to the movement of device **100**, the size of virtual object **5260** is adjusted. Adjusting the appearance of the virtual user interface object without regard to the manner of movement of the input (e.g., by allowing the user to adjust the appearance of the virtual user interface object with only movement of the input on the input device, with only movement of the cameras relative to the physical object, or with a combination of movement of the input and the cameras) provides an intuitive way for the user to adjust the appearance of the virtual user interface object, improves the visual feedback provided to the user (e.g., by making the computer system appear more responsive to user input), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by helping the user to achieve an intended outcome with the required inputs and reducing user mistakes when operating/interacting with the device), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0457] It should be understood that the particular order in which the operations in FIGS. **9**A-**9**E have been described is merely an example and is not intended to indicate that the described order is the only order in which the operations could be performed. One of ordinary skill in the art would recognize various ways to reorder the operations described herein. Additionally, it should be noted that details of other processes described herein with respect to other methods described herein (e.g., methods **600**, **700**, **800**, **1000**, **1100**, **1200**, and **1300**) are also applicable in an analogous manner to method **900** described above with respect to FIGS. **9**A-**9**E. For example, the contacts, gestures, user interface objects, intensity thresholds, focus indicators, and/or animations described above with reference to method **900** optionally have one or more of the characteristics of the contacts, gestures, user interface objects, intensity thresholds, focus indicators, and/or animations described herein with reference to other methods described herein (e.g., methods **600**, **700**, **800**, **1000**, **1100**, **1200**, and **1300**). For brevity, these details are not repeated here.

[0458] FIGS. **10**A-**10**E are flow diagrams illustrating method **1000** of transitioning between viewing modes of a displayed simulated environment, in accordance with some embodiments. Method **1000** is performed at a computer system (e.g., portable multifunction device **100**, FIG. **1**A, device **300**, FIG. **3**A, or a multi-component computer system including headset **5008** and input device **5010**, FIG. **5**A**2**) that includes (and/or is in communication with) a display generation component (e.g., a display, a projector, a heads-up display, or the like) and an input device (e.g., a touch-sensitive surface, such as a touch-sensitive remote control, or a touch-screen display that also serves as the display generation component, a mouse, a joystick, a wand controller, and/or cameras tracking the position of one or more features of the user such as the user's hands), optionally one or more cameras (e.g., video cameras that continuously provide a live preview of at least a portion of the contents that are within the field of view of the cameras and optionally generate video outputs including one or more streams of image frames capturing the contents within the field of view of the cameras), optionally one or more attitude sensors, optionally one or more sensors to detect intensities of contacts with the touch-sensitive surface, and optionally one or more tactile output generators. In some embodiments, the input device (e.g., with a touch-sensitive surface) and the display generation component are integrated into a touch-sensitive display. As described above with respect to FIGS. **3**B-**3**D, in some embodiments, method **1000** is performed at a computer system **301** (e.g., computer system **301**-*a*, **301**-*b*, or **301**-*c*) in which respective components, such as a display generation component, one or more cameras, one or more input devices, and optionally one or more attitude sensors are each either included in or in communication with computer system **301**.

[0459] In some embodiments, the display generation component is a touch-screen display and the input device (e.g., with a touch-sensitive surface) is on or integrated with the display generation component. In some embodiments, the display generation component is separate from the input device (e.g., as shown in FIG. **4**B and FIG. **5**A**2**). Some operations in method **1000** are, optionally, combined and/or the order of some operations is, optionally, changed.

[0460] For convenience of explanation, some of the embodiments will be discussed with reference to operations performed on a computer system with a touch-sensitive display system **112** (e.g., on device **100** with touch screen **112**) and one or more integrated cameras. However, analogous operations are, optionally, performed on a computer system (e.g., as shown in FIG. **5**A**2**) with a headset **5008** and a separate input device **5010** with a touch-sensitive surface in response to detecting the contacts on the touch-sensitive surface of the input device **5010** while displaying the user interfaces shown in the figures on the display of headset **5008**. Similarly, analogous operations are, optionally, performed on a computer system having one or more cameras that are implemented separately (e.g., in a headset) from one or more other components (e.g., an input device) of the computer system; and in some such embodiments, "movement of the computer system" corresponds to movement of one or more cameras of the computer system, or movement of one or more cameras in communication with the computer system.

[0461] As described below, method **1000** relates to detecting a gesture at an input device of a computer system. Depending on whether the gesture meets mode change criteria, a subsequent change in attitude (e.g., orientation and/or position) of at least a portion of the computer system relative to a physical environment either causes a transition from displaying the simulated environment in a first viewing mode (in which a fixed spatial relationship is maintained between a virtual user interface object and the physical environment) to a second viewing mode (in which the fixed spatial relationship between the virtual user interface object and the physical environment is not maintained) or changing an appearance of the first virtual user interface object in response to the change in attitude. Determining whether to transition from the first viewing mode to the second viewing mode or to change the appearance of the first virtual user interface object in the first viewing mode enables the performance of multiple different types of operations in response to a change in attitude of at least a portion of the computer system. Enabling the performance of multiple different types of operations in response to a change in attitude increases the efficiency with which the user is able to perform these operations, thereby enhancing the operability of the device, which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0462] In a first viewing mode, the computer system (e.g., device **100**, FIG. **5**C**1**) displays (**1002**) via a display generation component of the computer system (e.g., touch screen display **112**), a simulated environment (e.g., a virtual reality (VR) environment or an augmented reality (AR) environment) that is oriented relative to a physical environment of the computer system. Displaying the simulated environment in the first viewing mode includes displaying a first virtual user interface object (e.g., virtual box **5302**) in a virtual model (e.g., a rendered 3D model) that is displayed at a first respective location in the simulated environment that is associated with the physical environment of the computer system. For example, the visual appearance (e.g., as reflected in the size, location, and orientation) of the rendered 3D model changes depending on how the computer system is located and oriented relative to the tabletop or other surface in the physical environment.

[0463] While displaying the simulated environment (**1004**), the computer system detects, via the one or more attitude sensors, a first change in attitude (e.g., orientation and/or position) of at least a portion of the computer system (e.g., a change in attitude of a component of the computer system such as a component of the computer system that includes one or more cameras used to generate the representation of the physical environment) relative to the physical environment (e.g., a change caused by a first movement of the touch-screen display, the virtual reality headset, or the touch-sensitive remote control). For example, FIGS. **5C1**-**5C2** illustrate a first change in attitude of device **100**.

[0464] In response to detecting the first change in the attitude of the portion of the computer system (**1006**), the computer system changes an appearance of the first virtual user interface object in the virtual model so as to maintain a fixed spatial relationship (e.g., orientation, size and/or position) between the first virtual user interface object and the physical environment (e.g., the rendered 3D model is placed directly at the location of the tabletop or other surface that is in the field of view of the camera of the computer system and remains coplanar and stuck to the tabletop or other surface as the location of the tabletop or other surface changes in the field of view of the camera with the movement of the computer system). For example, from FIG. **5C1** to **5C2**, the size and position of virtual box **5302** on display **112** changes to maintain a fixed spatial relationship between virtual box **5302** and physical reference mat **5208***a*.

[0465] After changing the appearance of the first virtual user interface object based on the first change in attitude of the portion of the computer system (**1008**), the computer system detects, via the input device, a first gesture that corresponds to an interaction with the simulated environment (e.g., a pinch or swipe gesture on the touch-sensitive surface). FIGS. **5C4**-**5C6** provide an example of input that includes an upward swipe and a downward swipe (for moving virtual box **5302** in the simulated environment displayed by device **100**). FIGS. **5C9**-**5C11** provide an example of a pinch gesture (for zooming the simulated environment displayed by device **100**).

[0466] In response to detecting the first gesture that corresponds to the interaction with the simulated environment (**1010**), the computer system performs an operation in the simulated environment that corresponds to the first gesture (e.g., zooming, rotating, moving an object, etc.). FIGS. **5C4**-**5C6** illustrate movement of a virtual box **5302** in response to a detected swipe gesture. FIGS. **5C9**-**5C11** illustrate zooming the simulated environment in response to a detected pinch gesture.

[0467] After performing the operation that corresponds to the first gesture (**1012**), the computer system detects, via the one or more attitude sensors, a second change in attitude (e.g., orientation and/or position) of the portion of the computer system relative to the physical environment. For example, FIGS. **5C12-5C13** illustrate an attitude change that includes movement of device **100** relative to physical reference mat **5208***a* in physical environment **5200**.

[0468] In response to detecting the second change in the attitude of the portion of the computer system (**1014**), in accordance with a determination that the first gesture met mode change criteria, the computer system transitions from displaying the simulated environment, including the virtual model, in the first viewing mode to displaying the simulated environment, including the virtual model, in a second viewing mode. The mode change criteria include a requirement that the first gesture corresponds to an input that changes a spatial parameter (e.g., orientation, size and/or position) of the simulated environment relative to the physical environment (e.g., a pinch-to-zoom gesture to zoom out of the simulated environment, a depinch-to-zoom-out gesture to magnify the simulated environment, a swipe gesture to rotate or translate the simulated environment, and/or an input to display a point of view (POV) of another device viewing the simulated environment or a POV of a virtual object in the environment). For example, in response to the pinch-to-zoom input illustrated in FIGS. **5C9-5C11**, device **100** transitions from displaying the simulated environment in a first viewing mode (an augmented reality viewing mode) to displaying the simulated environment in a second viewing mode (a virtual reality viewing mode). For example, physical objects in the field of view of the camera of device **100**, such as physical reference mat **5208***a* and table **5204**, that are displayed by display **112** of device **100** in an augmented reality mode (e.g., in FIG. **5C9**), cease to be displayed in the virtual reality viewing mode (e.g., as shown in FIG. **5C12**). In the virtual reality viewing mode, a virtual grid **5328** is displayed (e.g., as shown in FIG. **5C12**). Displaying the virtual model in the simulated environment in the second viewing mode includes forgoing changing the appearance of the first virtual user interface object to maintain the fixed spatial relationship (e.g., orientation, size and/or position) between the first virtual user interface object and the physical environment (e.g., maintaining the first virtual user interface object at the same orientation, size and/or position as it was displayed prior to detecting the second change in attitude of the portion of the computer system). For example, as shown in FIGS. **5C12-5C13**, the position of virtual box **5302** relative to display **112** is unchanged in response to movement of device **100** while the device is displaying the simulated environment in a virtual reality viewing mode. In accordance with a determination that the first gesture did not meet the mode change criteria, the computer system continues to display the first virtual model in the simulated environment in the first viewing mode. For example, in FIGS. **5C4-5C6**, the swipe gesture for moving virtual box **5302** does not meet mode change criteria, and device **100** continues to display the simulated environment in an augmented reality viewing mode. Displaying the virtual model in the first viewing mode includes changing an appearance of the first virtual user interface object in the virtual model in response to the second change in attitude of the portion of the computer system (e.g., a change in attitude of a component of the computer system such as a component of the computer system that includes one or more cameras used to generate the representation of the physical environment) relative to the physical environment, so as to maintain the fixed spatial relationship (e.g., orientation, size and/or position) between the first virtual user interface object and the physical environment. For example, as shown in FIGS. **5C7-5C8**, the position of virtual box **5302** relative to display **112** changes in response to movement of device **100** while the device is displaying the simulated environment in an augmented reality viewing mode. In some embodiments, the fixed spatial relationship may have remained the same, or become different in response to other inputs, during the time between the first change in attitude and the second change in attitude, in some embodiments due to movement of the computer system or changes in the physical environment such as movement of the tabletop or other surface). In some embodiments, the computer system detects a plurality of gestures that correspond to respective interactions with the simulated environment, each gesture followed by a change in attitude of the portion of the computer system relative to the physical environment. In some such embodiments, the plurality of gestures and attitude changes include at least one gesture that met the mode change criteria, for which the computer system transitions from displaying the simulated environment in the first mode to displaying the simulated environment in the second mode, in response to detecting the subsequent change in attitude. In addition, the plurality of gestures and attitude changes include at least one gesture that did not meet the mode change criteria, for which the computer system continues to display the first virtual model in the simulated environment in the first viewing mode.

[0469] In some embodiments, the computer system includes (**1016**) one or more cameras (e.g., one or more video cameras that continuously provide a live preview of at least a portion of the contents that are within the field of view of the cameras and optionally generate video outputs including one or more streams of image frames capturing the contents within the field of view of the cameras) and displaying the simulated environment in the first viewing mode includes displaying a representation of at least a portion of a field of view of the one or more cameras. The field of view of the one or more cameras includes a representation of a physical object in the physical environment (e.g., the representation is a live view of at least a portion of the field of view of the one or more cameras). For example, one or more cameras of device **100** capture a live image of reference mat **5208***a*, which is displayed on display **112** as indicated at **5208***b*, as shown in FIG. **5C1**. In some embodiments, the view of the physical object is updated as the one or more cameras are moved and/or in response to changes to the virtual model. For example, from FIG. **5C1** to **5C2**, movement of device **100** causes the view **5208***b* of reference mat **5208***a* to change (e.g., as device **100** moves closer to reference mat **5208***a*, the simulated environment displayed on device **112** is updated from displaying a view **5208***b* of the entire reference mat **5208***a*, as shown in FIG. **5C1**, to a view **5208***b* of a portion of reference mat **5208***a*, as shown in FIG. **5C2**). Displaying a representation of a physical object in the simulated environment provides a user with simultaneous information about a physical environment and a simulated environment. Providing simultaneous information about a physical environment and a simulated environment enhances the operability of the device and makes the user-device interface more efficient (e.g., by helping the user to understand the relationship between input provided at the device, the virtual user interface object, and the physical environment and to avoid input mistakes), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0470] In some embodiments, detecting the first gesture that corresponds to the interaction with the simulated environment includes (**1018**) detecting a plurality of contacts (e.g., contacts **5324** and **5320** with a touch-sensitive surface of the input device (e.g., touch sensitive display **112** of device **100**), as indicated in FIG. **5C9**). While the plurality of contacts with the touch-sensitive surface are detected, the computer system detects movement of a first contact of the plurality of contacts relative to movement of a second contact of the plurality of contacts (e.g., movement of contacts **5324** and **5320** along paths indicated by arrows **5326** and **5322**, as indicated in FIGS. **5C9-5C11**). For example, the movement of a first contact of the plurality of contacts relative to movement of a second contact of the plurality of contacts is a pinch gesture that includes movement of the plurality of contacts that decreases the distance between at least the first contact and the second contact (e.g., as shown in FIGS. **5C9-5C11**), or a depinch gesture that includes movement of the plurality of contacts that increases the distance between at least the first contact and the second contact. In addition, in some embodiments, performing the operation in the simulated environment that corresponds to the first gesture includes altering a size of the first virtual user interface object (e.g., virtual box **5302**, FIG. **5C9**) by an amount that corresponds to the movement of the first contact relative to the movement of the second contact (e.g., in accordance with a determination that the gesture is a depinch gesture that includes movement of the contacts away from each other, increasing the size of the first virtual user interface object, and in accordance with a determination that the gesture is a pinch gesture that includes movement of the contacts toward each other, decreasing the size of the first virtual user interface object). For example, in FIGS. **5C9-5C11**, as contacts **5324** and **5320** move such that the distance between the contacts decreases, the size of virtual box **5302** decreases. Performing an operation in the simulated environment in response to a gesture, such as a depinch gesture, that interacts with the simulated environment provides an efficient and intuitive way for the user to alter the size of the first virtual user interface object (e.g., by allowing the user to zoom the virtual user interface object in the simulated environment using a single input gesture). Providing the user with gesture-based control of the simulated environment avoids cluttering the user interface with additional displayed controls, thereby enhancing the operability of the device and making the user-device interface more efficient, which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0471] In some embodiments, while displaying the first virtual user interface object in the simulated environment in the second viewing mode (e.g., a VR mode) (**1020**), the computer system detects, via the input device, a second gesture that corresponds to an interaction with the simulated environment. The second gesture includes input for altering a perspective of the simulated environment. For example, the computer system detects a gesture such as a swipe or rotational gesture (e.g., the input device includes a touch-screen display and the gesture includes movement of a contact across the touch-screen display). In addition, in response to detecting the second gesture that corresponds to the interaction with the simulated environment, the computer system updates a displayed perspective of the simulated environment in accordance with the input for altering the perspective of the simulated environment. For example, the computer system changes the displayed perspective of the simulated environment in a direction and by an amount that corresponds to a direction and amount of movement of the second gesture, such as a swipe or rotational gesture. FIGS. **5C22-5C23** illustrate an input that includes a rotational gesture by a contact **5350** that moves along a path indicated by arrow **5352**. As the input by contact **5350** is received, the simulated environment displayed by display **112** of device **100** is rotated in accordance with the input (e.g., virtual boxes **5302**, **5304**, and **5340** and virtual grid **5328** are rotated clockwise). Updating a displayed perspective of the simulated environment in response to detecting a gesture that corresponds to an interaction with the simulated environment provides an efficient and intuitive way for the user to alter the perspective of the simulated environment (e.g., by allowing the user to change the perspective of the simulated environment using a single input gesture). Providing the user with gesture-based control of the perspective of the simulated environment avoids cluttering the user interface with additional displayed controls, thereby enhancing the operability of the device and making the user-device interface more efficient, which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0472] In some embodiments, while displaying the simulated environment in the second viewing mode (e.g., a VR mode) (**1022**), the computer system detects, via an input device, an insertion input for inserting a second virtual user interface object at a second respective location in the simulated environment (e.g., an input, such as a tap input, directed to a location in the simulated environment that corresponds to an insertion cursor (created by a prior input) and/or an input directed to a control that, when activated, causes insertion of a new virtual user interface object at the location of a previously placed insertion cursor in the simulated environment). In response to detecting the insertion input for inserting the second virtual user interface object, the computer system displays, at the second respective location in the simulated environment, the second virtual user interface object while maintaining the fixed spatial relationship (e.g., orientation, size and/or position) between the first virtual user interface object and the physical environment. For example, an input (e.g., a tap input) by contact **5334** places an insertion cursor **5536**, as shown in FIGS. **5C15-5C16**. After the insertion cursor **5536** is placed, an input (e.g., a tap input) by contact **5338** at a location that corresponds to new object control **5216** is detected, as shown in FIG. **5C17**. In response to the input at the location that corresponds to new object control **5216** after placement of insertion cursor **5536**, virtual box **5340** is displayed at a position that corresponds to insertion cursor **5536**. Input for inserting a virtual user interface object is described further with regard to method **900**. In some embodiments, a respective viewing mode is not altered in response to insertion of the second virtual user interface object into the simulated environment (e.g., if the virtual user interface object is viewed in VR mode, no transition to AR mode occurs in response to insertion of the second virtual user interface object). Inserting a new virtual user interface object in response to an insertion input improves the feedback provided to the user (e.g., by making the computer system appear more responsive to user input), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by helping the user to achieve an intended outcome with the required inputs and reducing user mistakes when operating/interacting with the device), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0473] In some embodiments, while displaying the simulated environment in the second viewing mode (e.g., a VR mode) (**1024**), the computer system detects, via the input device, a movement input (e.g., a movement input by contact **5342**, FIG. **5C19**) that includes selection of a respective side of a respective virtual user interface object (e.g., side **5344** of virtual object **5340**) of the virtual model and movement of the input in two dimensions (e.g., as indicated by arrow **5346**). In response to detecting the movement, the computer system moves the respective virtual user interface object **5340** within a plane (e.g., as indicated by movement projections **5348**) that is parallel to the selected respective side of the respective virtual user interface object in a first direction determined based on the movement of the second input while maintaining the fixed spatial relationship (e.g., orientation, size and/or position) between the first virtual user interface object and the physical environment. In some embodiments, a direction of the movement of the respective virtual user interface object is determined based on a direction of the movement input (e.g., for movement input in a first direction, the virtual user interface object moves in a corresponding direction, and for movement input a second direction that is different from the first direction, the virtual user interface object moves in a different corresponding direction). In some embodiments, a magnitude of the movement of the respective virtual user interface object is determined based on a magnitude of the movement input (e.g., for a greater magnitude of movement input the respective virtual user interface object moves farther). Input for moving a virtual user interface object is described further with regard to method **900**. In some embodiments, a respective viewing mode is not altered in response to insertion of the second virtual user interface object into the simulated environment (e.g., if the virtual user interface object is viewed in VR mode, no transition to AR mode occurs in response to movement of the respective virtual user interface object). Moving a virtual user interface object in response to a movement input improves the feedback provided to the user (e.g., by making the computer system appear more responsive to user input), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by helping the user to achieve an intended outcome with the required inputs and reducing user mistakes when operating/interacting with the device), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0474] In some embodiments, while transitioning from displaying the simulated environment in the first viewing mode to displaying the simulated environment in the second viewing mode (**1026**), the computer system displays a transition animation to provide a visual indication of the transition (e.g., as illustrated at FIGS. **5C9-5C12**). Displaying a transition animation while transitioning from displaying the simulated environment in the first viewing mode (e.g., the AR mode) to displaying the simulated environment in the second viewing mode (e.g., the VR mode) improves the feedback provided to the user (e.g., by providing an indication to the user that a transition from an AR mode to a VR mode is taking place), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by helping the user to understand the input that causes a viewing mode transition and to achieve a viewing mode transition when desired), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0475] In some embodiments, displaying the transition animation includes (**1028**) gradually ceasing to display at least one visual element (e.g., a live background view and/or one or more physical reference objects (or any other aspect of the physical environment) as captured by one or more cameras of the computer system) that is displayed in the first viewing mode and is not displayed in the second viewing mode. For example, in FIGS. **5C9-5C11**, table **5204** and displayed view **5208*b*** of physical reference mat **5208*a*** gradually cease to be displayed on display **112**. Gradually ceasing to display at least one visual element that is displayed in the first viewing mode and is not displayed in the second viewing mode while transitioning from displaying the simulated environment in the first viewing mode to displaying the simulated environment in the second viewing mode improves the feedback provided to the user (e.g., by removing aspects of the physical environment to provide a visual cue to the user that a fixed spatial relationship between the first virtual user interface object and the physical environment is not being maintained), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by helping the user to understand the effect of the transition), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0476] In some embodiments, displaying the transition animation includes (**1030**) gradually displaying at least one visual element (e.g., a rendered background) of the second viewing mode that is not displayed in the first viewing mode. For example, in FIGS. **5C11-5C12**, virtual reference grid **5328** is gradually displayed on display **112**.

[0477] Gradually displaying at least one visual element of the second viewing mode that is not displayed in the first viewing mode while transitioning from displaying the simulated environment in the first viewing mode to displaying the simulated environment in the second viewing mode improves the feedback provided to the user (e.g., by adding aspects of a virtual reality environment to provide a visual cue to the user that a transition from an augmented reality viewing mode to a virtual reality viewing mode is occurring), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by helping the user to understand the effect of the transition), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0478] In some embodiments, while transitioning from displaying the simulated environment in the second viewing mode to displaying the simulated environment in the first viewing mode (e.g., in response to a mode change input gesture), a transition animation is displayed to provide a visual indication of the transition (e.g., as illustrated at

FIGS. **5C26-5C30**). In some embodiments, the transition includes gradually ceasing to display at least one visual element of the second viewing mode (e.g., the rendered background) and gradually displaying at least one visual element that is displayed in the first viewing mode (e.g., a live background view and/or one or more physical reference objects (or any other aspect of the physical environment) as captured by one or more cameras of the computer system). For example, in FIGS. **5C26-5C27**, virtual reference grid **5328** gradually ceases to be displayed, and in FIGS. **5C28-5C30**, table **5204** and displayed view **5208***b* of physical reference grid **5208***a* are gradually redisplayed.

[0479] In some embodiments, in response to detecting the first gesture that corresponds to the interaction with the simulated environment (**1032**), the computer system alters a perspective with which the virtual model in the simulated environment is displayed in accordance with the change to the spatial parameter by the input that corresponds to the first gesture. For example, in response to the pinch-to-zoom gesture illustrated at FIGS. **5C9-5C11**, the displayed sizes of virtual boxes **5302** and **5304** decrease. In some embodiments, if the first gesture is a gesture to zoom in on the virtual model (e.g., a depinch gesture), the displayed perspective of the virtual model in the simulated environment is changed such that the displayed size of the virtual model increases. In some embodiments, if the first gesture is a gesture to pan or otherwise move the displayed virtual model (e.g., a swipe gesture), the displayed perspective of the virtual model in the simulated environment is changed such that the virtual model is panned or otherwise moved in accordance with the input gesture. Altering a perspective of the simulated environment in response to detecting the first gesture improves the feedback provided to the user (e.g., by making the computer system appear more responsive to user input), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by helping the user to achieve an intended outcome with the required inputs and reducing user mistakes when operating/interacting with the device), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0480] In some embodiments, after detecting an end of the first gesture (**1034**), the computer system continues to alter a perspective with which the virtual model in the simulated environment is displayed to indicate the transitioning from displaying the simulated environment in the first viewing mode to displaying the simulated environment in the second viewing mode. For example, in FIGS. **5C12-5C13**, after liftoff of the contacts **5320** and **5324** that provided the pinch-to-zoom input that caused the size of virtual boxes **5302** and **5304** to decrease in FIGS. **5C9-5C11**, the displayed size of virtual boxes **5302** and **5304** continues to decrease. In some embodiments, the perspective with which the virtual model in the simulated environment is displayed continues to be altered in response to the second change in the attitude of the portion of the computer system. In some embodiments, the perspective continues to be altered without a change in attitude of the portion of the computer system (or other input), for example to alter the perspective by a predetermined amount and/or to display a predetermined view of the simulated environment in the second viewing mode. Continuing to alter a perspective of the simulated environment after a first gesture has ended enhances the operability of the device, and makes the user-device interface more efficient (e.g., by increasing the amount of alteration to the perspective that corresponds to movement of the focus selector(s) (e.g., one or more contacts)), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0481] In some embodiments, while displaying the simulated environment in the second viewing mode (**1036**), the computer system detects, via the input device, a third gesture that corresponds to an input for transitioning from the second viewing mode to the first viewing mode. For example, the third gesture is an input that includes a depinch gesture by contacts **5360** and **5356**, as shown in FIGS. **5C26-5C27**. In response to detecting the third gesture, the computer system transitions from displaying the simulated environment in the second viewing mode to displaying the simulated environment in the first viewing mode (e.g., in response to a subsequent change in attitude of a portion of the computer system, the appearance of the first virtual user interface object will change relative to the physical environment so as to maintain the fixed spatial relationship between the first user interface object and the physical environment). In some embodiments, displaying the first virtual user interface object in the first viewing mode of the simulated environment includes displaying a live feed from one or more cameras of the computer system in the background of the virtual model in the simulated environment. Transitioning from the second viewing mode (e.g., the VR mode) to the first viewing mode (e.g., the AR mode) in response to a gesture input provides the user with the ability to control toggling between the VR mode and the AR mode. Providing the user with gesture-based control of the viewing mode enhances the operability of the device, makes the user-device interface more efficient (e.g., by allowing the user to select the viewing mode that is most efficient for the type of input the user wishes to provide, and by providing additional control options without cluttering the user interface with additional displayed controls), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0482] In some embodiments, the input device includes (**1038**) a touch-sensitive surface (e.g., touch sensitive display **112** of device **100**), and detecting the third gesture that corresponds to the input for transitioning from the second viewing mode to the first viewing mode includes detecting the plurality of contacts (e.g., contacts **5356** and **5360**) with the touch-sensitive surface of the input device. While the plurality of contacts with the touch-sensitive surface are detected, the input device detects movement of the first contact of the plurality of contacts relative to movement of the second contact of the plurality of contacts (e.g., movement by contact **5356** along a path indicated by arrow **5358** and movement by contact **5360** along a path indicated by arrow **5362**). In some embodiments, the third gesture is a pinch gesture that includes movement of the plurality of contacts that reduces the distance between the first contact and the second contact. In some embodiments, transitioning from displaying the simulated environment in the second viewing mode to displaying the simulated environment in the first viewing mode includes altering a size of the virtual model in the simulated environment to return to a size of the virtual model prior to the transition from the first viewing mode to the second viewing mode. For example, as shown in FIGS. **5C26-5C30**, in response to the gesture by contact **5356** and **5360**, virtual boxes **5302** and **5304** are changed back to their original positions and sizes relative to physical reference mat **5208***a*. Transitioning from displaying the simulated environment in the second viewing mode (e.g., the VR mode) to displaying the simulated environment in the first viewing mode (e.g., the AR mode) in response to an input gesture (e.g., a pinch gesture) provides an efficient and intuitive way for the user to select a desired viewing mode. Providing the user with gesture-based control of the viewing mode enhances the operability of the device and makes the user-device interface more efficient (e.g., by providing additional control options without cluttering the user interface with additional displayed controls), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0483] In some embodiments, the third gesture includes (**1040**) an input (e.g., a tap input) at a position on the input device that corresponds to a control (e.g., a position in the simulated environment that does not correspond to the virtual model and/or a control with an image and/or text associated with the AR mode) that, when activated, causes the transition from the second viewing mode to the first viewing mode. For example, the third gesture includes input at a location that corresponds to toggle **5214**, FIG. **5C28** (e.g., for toggling between a virtual reality display mode and an augmented reality display mode). Transitioning from displaying the simulated environment in the second viewing mode (e.g., the VR mode) to displaying the simulated environment in the first viewing mode (e.g., the AR mode) in response to an input at a control provides an efficient and intuitive way for the user to select a desired viewing mode. Providing the user with a control for causing transition of the viewing mode enhances the operability of the device and makes the user-device interface more efficient, which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0484] In some embodiments, in response to detecting the third gesture (**1042**), the computer system transitions (e.g., by rotating, resizing, and/or moving the first virtual user interface object and the virtual model) the position of the first virtual user interface object from a current position relative to the physical environment to a prior position relative to the physical environment so as to return to the fixed spatial relationship between the first virtual user interface object and the physical environment. For example, as shown in FIGS. **5C26-5C30**, in response to the gesture by contact **5356** and **5360**, virtual boxes **5302** and **5304** are rotated, resized, and moved, such that in FIG. **5C30**, virtual objects **5302** and **5304** are returned to the positions that virtual boxes **5302** and **5304** had relative to physical reference mat **5208***a* in FIG. **5C3** (in which device **100** displayed virtual objects **5302** and **5304** in an augmented reality mode). In some circumstances (e.g., where the device has been moved in the physical environment since transitioning from the first viewing mode to the second viewing mode), the position of the first virtual user interface object on the display after transitioning back from the second viewing mode to the first viewing mode is different from the position of the first virtual user interface object on the display prior to transitioning from the first viewing mode to the second viewing mode (e.g., because the device has moved so that a destination location for the first virtual user interface object is in a different position on the display than it was prior to transitioning from the first viewing mode to the second viewing mode). For example, because the orientation of device **110** in FIG. **5C30** is different from the orientation of device **100** in FIG. **5C3**, the positions of virtual boxes **5302** and **5304** on display **112** in FIG. **5C30** are different from the positions of virtual boxes **5302** and **5304** on display **112** in FIG. **5C3** (although positions of virtual boxes **5302** and **5304** relative to physical reference mat **5208***a* is the same in FIG. **5C3** and FIG. **5C30**). Transitioning a position of a virtual user interface object to return the object to a fixed spatial relationship with the physical environment improves the feedback provided to the user (e.g., by making the computer system appear more responsive to user input), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by providing a visual cue to help the user understand that a transition to a viewing mode in which the virtual user interface object has a fixed spatial relationship with the physical environment is occurring, thereby helping a user achieve an intended outcome with the required inputs), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0485] In some embodiments, after detecting an end of the third gesture (**1044**), the computer system continues to alter a perspective with which the virtual model in the simulated environment is displayed to indicate the transitioning from displaying the simulated environment in the second viewing mode to displaying the simulated environment in the first viewing mode. For example, in FIGS. **5C28-5C30**, after liftoff of the contacts **5356** and **5360** that provided the depinch-to-zoom-out input that caused the size of virtual boxes **5302** and **5304** to increase in FIGS. **5C26-5C27**, the displayed size of virtual boxes **5302** and **5304** continues to increase. In some embodiments, the perspective continues to be altered without a change in attitude of the portion of the computer system (or other input), for example, to alter the perspective by a predetermined amount and/or to display a predetermined view of the simulated environment in the second viewing mode. Continuing to alter a perspective of the simulated environment after a first gesture has ended enhances the operability of the device, and makes the user-device interface more efficient (e.g., by increasing the amount of alteration to the perspective that corresponds to movement of the focus selector(s) (e.g., one or more contacts)), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0486] It should be understood that the particular order in which the operations in FIGS. **10A-10E** have been described is merely an example and is not intended to indicate that the described order is the only order in which the operations could be performed. One of ordinary skill in the art would recognize various ways to reorder the operations described herein. Additionally, it should be noted that details of other processes described herein with respect to other methods described herein (e.g., methods **600**, **700**, **800**, **900**, **1100**, **1200**, and **1300**) are also applicable in an analogous manner to method **1000** described above with respect to FIGS. **10A-10E**. For example, the contacts, gestures, user interface objects, focus indicators, and/or animations described above with reference to method **1000** optionally have one or more of the characteristics of the contacts, gestures, user interface objects, intensity thresholds, focus indicators, and/or animations described herein with reference to other methods described herein (e.g., methods **600**, **700**, **800**, **900**, **1100**, **1200**, and **1300**). For brevity, these details are not repeated here.

[0487] FIGS. **11A-11C** are flow diagrams illustrating method **1100** for updating an indication of a viewing perspective of a second computer system in a simulated environment displayed by a first computer system, in accordance with some embodiments, in accordance with some embodiments. Method **1100** is performed at a computer system (e.g., portable multifunction device **100**, FIG. **1**A, device **300**, FIG. **3**A, or a multi-component computer system including headset **5008** and input device **5010**, FIG. **5**A**2**) that includes (and/or is in communication with) a display generation component (e.g., a display, a projector, a heads-up display, or the like) and an input device (e.g., a touch-sensitive surface, such as a touch-sensitive remote control, or a touch-screen display that also serves as the display generation component, a mouse, a joystick, a wand controller, and/or cameras tracking the position of one or more features of the user such as the user's hands), optionally one or more cameras (e.g., video cameras that continuously provide a live preview of at least a portion of the contents that are within the field of view of the cameras and optionally generate video outputs including one or more streams of image frames capturing the contents within the field of view of the cameras), optionally one or more attitude sensors, optionally one or more sensors to detect intensities of contacts with the touch-sensitive surface, and optionally one or more tactile output generators. In some embodiments, the input device (e.g., with a touch-sensitive surface) and the display generation component are integrated into a touch-sensitive display. As described above with respect to FIGS. **3**B-**3**D, in some embodiments, method **1100** is performed at a computer system **301** (e.g., computer system **301**-*a*, **301**-*b*, or **301**-*c*) in which respective components, such as a display generation component, one or more cameras, one or more input devices, and optionally one or more attitude sensors are each either included in or in communication with computer system **301**.

[0488] In some embodiments, the display generation component is a touch-screen display and the input device (e.g., with a touch-sensitive surface) is on or integrated with the display generation component. In some embodiments, the display generation component is separate from the input device (e.g., as shown in FIG. **4**B and FIG. **5**A**2**). Some operations in method **1100** are, optionally, combined and/or the order of some operations is, optionally, changed.

[0489] For convenience of explanation, some of the embodiments will be discussed with reference to operations performed on a computer system with a touch-sensitive display system **112** (e.g., on device **100** with touch screen **112**) and one or more integrated cameras. However, analogous operations are, optionally, performed on a computer system (e.g., as shown in FIG. **5**A**2**) with a headset **5008** and a separate input device **5010** with a touch-sensitive surface in response to detecting the contacts on the touch-sensitive surface of the input device **5010** while displaying the user interfaces shown in the figures on the display of headset **5008**. Similarly, analogous operations are, optionally, performed on a computer system having one or more cameras that are implemented separately (e.g., in a headset) from one or more other components (e.g., an input device) of the computer system; and in some such embodiments, "movement of the computer system" corresponds to movement of one or more cameras of the computer system, or movement of one or more cameras in communication with the computer system.

[0490] As described below, method **1100** relates to a first computer system of a first user that displays a visual indication of a viewing perspective of a second computer system of a second user. The visual indication is displayed in a simulated environment that is oriented relative to the physical environment of the first user. When the viewing perspective of the second computer system changes, the visual indication of the viewing perspective is updated. Updating a visual indication of the viewing perspective of a second computer system in a simulated environment displayed by a first computer system enables collaboration between users of multiple computer systems. Enabling collaboration between users of multiple devices increases the efficiency with which the first user is able to perform operations in the simulated environment (e.g., by allowing a second user of the second computer system to contribute to a task, reducing the amount of contribution to the task required by the first user of the first computer system), thereby enhancing the operability of the computer system, which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the computer system more quickly and efficiently.

[0491] The first computer system (e.g., device **5406**, FIG. **5**D**1**) displays (**1102**), via the first display generation component of the first computer system, a simulated environment (e.g., a virtual reality environment or an augmented reality environment) that is oriented relative to a first physical environment of the first computer system (e.g., as shown at display **5418** of device **5406** in FIG. **5**D**2**). Displaying the simulated environment includes (**1104**) concurrently displaying: a first virtual user interface object (e.g., virtual box **5420**, FIG. **5**D**3***b*) in a virtual model (e.g., a rendered 3D model) that is displayed at a respective location in the simulated environment that is associated with the first physical environment of the first computer system **5406** (e.g., the visual appearance (e.g., as reflected in the size, location, and orientation) of the rendered 3D model changes depending on how the computer system is located and oriented relative to the tabletop or other surface in the physical environment) and a visual indication (e.g., viewing perspective indicator **5432**, FIG. **5**D**3***b*) of a viewing perspective of a second computer system **5412** of the simulated environment. The second computer system **5412** is a computer system having a second display generation component (e.g., a display, a projector, a heads-up display, or the like), one or more second attitude sensors (e.g., one or more cameras, gyroscopes, inertial measurement units, or other sensors that enable the computer system to detect changes in an orientation and/or position of the computer system relative to a physical environment of the computer system), and a second input device (e.g., a touch-sensitive surface), that is displaying, via the second display generation component of the second computer system (e.g., as shown in FIG. **5**D**3***c*), a view of the simulated environment that is oriented relative to a second physical environment of the second computer system **5412** (e.g., an augmented reality view including the first virtual user interface object **5402** overlaid on at least a portion of a live image output from the camera of the second computer system).

[0492] While displaying the simulated environment via the first display generation component of the first computer system (**1106**), the first computer system **5406** detects a change in the viewing perspective of the second computer system **5412** of the simulated environment (e.g., as illustrated at FIGS. **5**D**3**-**5**D**4**) based on a change in the attitude of a portion of the second computer system relative to the second physical environment of the second computer system (e.g., a change in the attitude of the portion of the second computer system and/or a change in the attitude of at least a portion of the physical environment such as a change in the attitude of a physical object used as a marker by the second computer system).

[0493] In response to detecting the change in the viewing perspective of the second computer system of the simulated environment based on the change in the attitude of the portion of the second computer system **5412** relative to the physical environment of the second computer system (**1108**), the first computer system **5406** updates the visual indication of the viewing perspective of the second computer system **5412** of the simulated environment displayed via the first display generation component of the first computer system **5406** in accordance with the change in the viewing perspective of the second computer system **5412** of the simulated environment. For example, as shown in FIG. **5**D**3***b*, the display of first computer system **5406** displays the viewing perspective indicator **5432** that corresponds to second computer system **5412**. The viewing perspective indicator **5432** is updated from FIG. **5**D**3***b* to FIG. **5**D**4***b* based on the change in position of second computer system **5412** (as shown in FIGS. **5**D**3***a* to FIG. **5**D**4***a*).

[0494] In some embodiments, the visual indication of the viewing perspective of the second computer system includes (**1110**) a representation of the second computer system (e.g., a view of the second computer system as detected by the one or more cameras of the first computer system and/or a virtual representation of the second computer system) that is displayed at a position in the simulated environment that corresponds to the second computer system. For example, as shown in FIG. **5**D**3***b*, the display of first computer system **5406** displays avatar **5428** that corresponds to second computer system **5412**. Displaying a representation of the second computer system at a position that corresponds to the second computer system improves the information available to the first user about the second computer system (e.g., to help the user understand that that the visual indication of the viewing perspective corresponds to a remote computer system). Improving the information available to the first user about the second computer system enhances the operability of the device (e.g., by allowing the user to collaborate more effectively with other users), and makes the user-device interface more efficient, which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0495] In some embodiments, the representation of the second computer system includes (**1112**) an identification indicator (e.g., text, a 2D image (such as an emoji, or a photograph), and/or a 3D model) that corresponds to the second computer system. For example, avatar **5428** as shown in FIG. **5**D**3***b* is an identification indicator that corresponds to second computer system **5412**. Displaying an identification indicator for the second computer system at a position that corresponds to the second computer system improves the information available to the first user about the second computer system. Improving the information available to the first user about the second computer system makes the user-device interface more efficient (e.g., by helping the first user to distinguish between the visual indicator of the viewing perspective of the second user and visual indicators of the viewing perspectives of other users of remote computing systems), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0496] In some embodiments, the visual indication of the viewing perspective of the second computer system **5412** includes (**1114**) an indicator **5432** that emanates (e.g., as a cone, such as a cone of particles, or one or more rays) from a position in the simulated environment that corresponds to the second computer system **5412** to indicate a line of sight of the second computer system. In some embodiments, the one or more rays include at least one ray that does not extend to (any) user interface objects in the virtual model. For example, the one or more rays do not connect to the first virtual user interface object **5420**. In some embodiments, the visual indicator **5432** gets wider as it extends further from the representation of the second computer system **5412** to more accurately represent the field of view of the second computer system **5412**. Displaying an indicator to indicate a line of sight of the second computer system improves the information available to the first user about the second computer system (e.g., by providing a cue to help the first user understand what the second user is viewing on the display of the second computer system and objects in that view with which the second user will potentially interact). Improving the information available to the first user about the second computer system makes the user-device interface more efficient (e.g., by allowing the user to collaborate more effectively with other users), which, additionally, reduces power usage and improves battery life of the device by enabling the first user to use the device more quickly and efficiently.

[0497] In some embodiments, displaying the simulated environment includes (**1116**), in accordance with a determination that the second computer system **5412** in the simulated environment is interacting with the first virtual user interface object **5420** (e.g., the second computer system has selected the first user interface object **5420**, is moving the first user interface object **5420**, and/or is changing a size and/or shape of the first user interface object **5420**), displaying, via the first display generation component of the first computer system **5406**, an interaction indicator (e.g., interaction indicator **5452**, as shown in FIG. **5**D**5***b*) that is visually associated with the first virtual user interface object **5420**. In some embodiments, in accordance with a determination that the second computer system **5412** in the simulated environment is interacting with a second virtual user interface object (e.g., the second computer system **5412** has selected the second user interface object, is moving the second user interface object, and/or is changing a size and/or shape of the second user interface object), the first computer system **5406** displays, via the first display generation component of the first computer system, an interaction indicator that is visually associated with the second virtual user interface object. Displaying an interaction indicator **5452** that indicates a virtual user interface object with which the second computer system **5412** is interacting improves collaboration between users of multiple computer systems.

Improving the collaboration between users of multiple computer systems increases the efficiency with which the users perform operations in the simulated environment (e.g., by allowing a second user of the second computer system to contribute to tasks that involve the virtual user interface object, reducing the amount of contribution to the task required by the first user of the first computer system), thereby enhancing the operability of the computer system, which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the computer system more quickly and efficiently.

[0498] In some embodiments, displaying the simulated environment includes (**1118**), in accordance with a determination that the interaction of the second computer system **5412** with the first virtual user interface object **5420** includes an object manipulation input, changing an appearance of the first virtual user interface object (e.g., by moving, expanding, contracting, and/or otherwise changing the size, shape, and/or position of the first virtual user interface object **5420**) in accordance with the object manipulation input. For example, in FIGS. **5**D**5***b*-**5**D**6***b*, virtual user interface object **5420** is moved in response to a movement input illustrated at FIGS. **5**D**5***c*-**5**D**6***c*. In FIGS. **5**D**9***b*-**5**D**10***b*, the size of virtual user interface object **5420** is changed in response to a resizing input illustrated at FIGS. **5**D**9***c*-**5**D**10***c*. Changing an appearance of a virtual user interface object in accordance with an input by the second computer system that manipulates the virtual user interface object improves collaboration between users of multiple computer systems. Improving the collaboration between users of multiple computer systems increases the efficiency with which the users perform operations in the simulated environment (e.g., by revealing to the first user contributions by a second user to a task involving the virtual user interface object, reducing the amount of contribution to the task required by the first user of the first computer system), thereby enhancing the operability of the computer system, which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the computer system more quickly and efficiently.

[0499] In some embodiments, changing the appearance of the first virtual user interface object **5420** in accordance with the object manipulation input includes (**1120**) displaying movement of the interaction indicator **5452** that is visually associated with the first virtual user interface object **5420**, and the movement of the interaction indicator corresponds to the object manipulation input (e.g., as shown in FIGS. **5**D**5***b*-**5**D**6***b*). For example, a portion of the interaction indicator **5452** (e.g., an endpoint of the interaction indicator **5452**) is displayed at a location that corresponds to a point on the first virtual user interface object **5420** such that the portion moves as the point on the first virtual user interface object changes due to a change in position and/or size of the first virtual user interface object. Moving an interaction indicator in accordance with input of the second computer system that manipulates the virtual user interface object improves information available to the first user about the second computer system (e.g., by providing a visual cue to the first user about the connection between the change to the virtual user interface object and the second computer system, helping the user to understand that the virtual user interface object is changed as a result of input received at the second computer system). Improving the information available to the first user makes the user-device interface more efficient (e.g., by allowing the first user to collaborate more effectively with other users), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0500] In some embodiments, the interaction indicator **5452** includes (**1122**) a visual indication of a connection (e.g., a line) between a position that corresponds to the second computer system in the simulated environment and the first virtual user interface object. For example, in FIG. **5**D**5***b*, interaction indicator **5452** is shown as a line between avatar **5428** (that identifies second computer system **5412**) and virtual box **5420**. Displaying an interaction indicator that includes a visual indication of a connection between the displayed position of the second computer system and the virtual user interface object improves information available to the first user about the second computer system (e.g., by providing a visual cue to the first user about the connection between the virtual user interface object and the second computer system that is interacting with the virtual user interface object, helping the user to understand that the second computer system is interacting with the virtual user interface object). Improving the information available to the first user makes the user-device interface more efficient (e.g., by allowing the first user to collaborate more effectively with other users), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0501] In some embodiments, the interaction indicator **5452** includes (**1124**) a visual indication of a point of interaction (e.g., control handle **5454**, FIG. **5**D**5***b*) with the first user interface object **5420**. For example, a point of connection (e.g., a dot) is displayed at a point where the visual indication of the connection meets the first user interface object **5420**. In some embodiments, the point of connection indicates a point, side, control handle, or other portion of the object with which the user is interacting. In some embodiments, when the second computer system starts interacting with a different portion of the first user interface object, the interaction indicator changes to indicate the point of interaction between the first user interface object and the second computer system. Displaying an interaction indicator that includes a visual indication of a point of interaction with the virtual user interface object improves information available to the first user about the second computer system (e.g., by providing a visual cue to the first user about the way in which the second computer system is interacting with the virtual user interface object, helping the user to understand how the second computer system is interacting with the virtual user interface object and predict the changes that will be made by the second computer system). Improving the information available to the first user makes the user-device interface more efficient (e.g., by allowing the first user to collaborate more effectively with other users), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0502] In some embodiments, displaying the simulated environment includes (**1126**) detecting, via the first computer system **5406** (e.g., using one or more sensors of the first computer system, such as one or more cameras (e.g., video cameras that continuously provide a live preview of at least a portion of the contents that are within the field of view of the cameras and optionally generate video outputs including one or more streams of image frames capturing the contents within the field of view of the cameras)), a first physical reference object (e.g., a first reference mat **5416***a*, FIG. **5**D**4***a*) in the first physical environment. In some embodiments, the physical reference object is a device that includes one or more sensors for detecting position and one or more communication components configured to transmit the position information. In some embodiments, a position of a physical reference object is detected by a device that is remote from the first physical reference object and the first computer system. In some embodiments, displaying the simulated environment also includes displaying, in the simulated environment displayed via the first display generation component of the first computer system, the first virtual user interface object **5420** at a position relative to the first physical reference object (e.g., a visual representation of the first physical reference object, such as a live camera view of the first physical reference object and/or a virtual model that corresponds to the first physical reference object). In response to detecting the change in the viewing perspective of the second computer system **5412**, the first computer system updates the position of the interaction indicator **5462** relative to the first physical reference object **5416***a* (e.g., as shown in FIGS. **5**D**9***a*-**5**D**10***a* and **5**D**9***b*-**5**D**10***b*, the position interaction indicator **5462** changes as the position of device **5412** changes. In some embodiments, the visual indication **5432** of the viewing perspective of the second computer system **5412** is also updated to indicate the change in the viewing perspective of the second computer system. Updating the position of the interaction indicator relative to a physical reference object as the viewing perspective of the second computer system changes improves information available to the first user about the second computer system (e.g., by providing a visual cue to the first user about the relative positioning of the second computer system and the physical environment, helping the first user to understand how the second user of the second computer system views the simulated environment). Improving the information available to the first user makes the user-device interface more efficient (e.g., by allowing the first user to collaborate more effectively with other users), which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0503] In some embodiments, the second physical environment of the second computer system is (**1128**) distinct from the first physical environment of the first computer system. For example, FIG. **5**D**12***b* illustrates a second physical environment **5470** that is distinct from first physical environment **5400**. The second computer system (e.g., device **5478**, FIG. **5**D**12***b*) detects (e.g., using one or more sensors of the second computer system, such as one or more cameras) a second physical reference object (e.g., a second reference mat **5476***a*) in the second physical environment **5470**. In some embodiments, the first physical reference object (e.g., physical reference mat **5416***a*, FIG. **5**D**12***a*) and the second physical reference object (e.g., physical reference mat **5476***a*, FIG. **5**D**12***b*) have one or more shared characteristics (e.g., the same area, shape, and/or reference pattern). In some embodiments, in the simulated environment displayed via the second display generation component of the second computer system (e.g., as shown in FIG. **5**D**14***c*), the first virtual user interface object **5420** is displayed at a location relative to the second physical reference object (e.g., a visual representation **5476***b* of the second physical reference object **5476***a*, such as a live camera view **5476***b* of the second physical reference object **5476***a* and/or a virtual model that corresponds to (e.g., is anchored to a live camera view of) the second physical reference object) the location of the first virtual user interface object **5420** relative to the first physical reference object **5416***a*. For example, a second anchoring position is at a same position relative to the boundary of the second physical reference object **5476***a* as the position of the first anchoring position relative to the boundary of first reference object **5146***a* (e.g., if the first anchoring position is at the center of the first physical reference object **5146***a*, the second anchoring position is at the center of the second physical reference object **5476***a*, and/or vice versa). If a movement input causes the position of the first virtual user interface object to move along a first path relative to the first physical reference object, the position of the first virtual user interface object in the simulated environment displayed via the second display generation component moves along a second path, relative to the second physical reference object, that has the same trajectory as the first path relative to the first physical reference object. Displaying a virtual user interface object at a location relative to a first physical reference object in a simulated environment displayed by a first computer system and displaying the same virtual user interface object at a location relative to a second physical reference object in a simulated environment displayed by a second computer system enables a first user and a second user to collaborate in a shared simulated environment while the first user and the second user are not at the same physical location. Enabling a first user and a second user to collaborate in a shared simulated environment while the first user and the second user are not at the same physical location improves the collaboration between users of multiple computer systems, which increases the efficiency with which the users perform operations in the simulated environment (e.g., by revealing to the first user contributions by a second user to a task involving the virtual user interface object, reducing the amount of contribution to the task required by the first user of the first computer system), thereby enhancing the operability of the computer system, which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the computer system more quickly and efficiently.

[0504] In some embodiments, the first physical environment **5400** of the first computer system includes (**1130**) at least a portion of the second physical environment of the second computer system (e.g., the first computer system **5408** and the second computer system **5412** are in the same (local) physical space, as shown in FIG. **5**D**1**) and the second computer system (e.g., a live image of the second computer system and/or a virtual version of second computer system (e.g., overlaid over the live image of the second computer system)) is visible in the simulated environment displayed via the first display generation component. For example, in FIG. **5**D**4***b*, a representation **5430** of device **5412** (e.g., a view of device **5412** as captured by a camera of device **5406** and/or a rendered version of device **5412**) is shown. Displaying the second computer system in a simulated environment displayed by a first computer system when the first computer system and the second computer system are at least partly in the same physical environment improves collaboration between the first user of the first computer system and the second user of the second computer system (e.g., by helping the first user understand the location of the second computer system relative to the first computer system). Improving collaboration between the first user of the first computer system and the second user of the second computer system increases the efficiency with which the first user performs operations in the simulated environment, thereby enhancing the operability of the computer system, which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the computer system more quickly and efficiently.

[0505] In some embodiments, the first computer system detects (**1132**), by the first input device **5406**, a remote device perspective input (e.g., an input detected at a user interface control, such as a button and/or menu item, or a gesture input such as a swipe gesture) and, in response to detecting the remote device perspective input, the first computer system replaces display of the simulated environment that is oriented relative to the first physical environment of the first computer system with display of the simulated environment that is oriented relative to the second physical environment of the second computer system. For example, in response to the input, device **5406** displays a view of device **5412**, such as the view illustrated in FIG. **5**D**4***c*. Replacing display of the simulated environment of the first computer system with display of the simulated environment of the second computer system in response to input at the first input device of the first computer system improves collaboration between the first user of the first computer system and the second user of the second computer system (e.g., by allowing the first user to accurately visualize the perspective of another user). Improving collaboration between the first user of the first computer system and the second user of the second computer system increases the efficiency with which the first user performs operations in the simulated environment (e.g., by allowing the first user to use information about the second user's perspective to communicate accurately about the viewed user interface object), thereby enhancing the operability of the computer system, which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the computer system more quickly and efficiently.

[0506] It should be understood that the particular order in which the operations in FIGS. **11**A-**11**C have been described is merely an example and is not intended to indicate that the described order is the only order in which the operations could be performed. One of ordinary skill in the art would recognize various ways to reorder the operations described herein. Additionally, it should be noted that details of other processes described herein with respect to other methods described herein (e.g., methods **600**, **700**, **800**, **900**, **1000**, **1200**, and **1300**) are also applicable in an analogous manner to method **1100** described above with respect to FIGS. **11**A-**11**C. For example, the contacts, gestures, user interface objects, focus indicators, and/or animations described above with reference to method **1100** optionally have one or more of the characteristics of the contacts, gestures, user interface objects, intensity thresholds, focus indicators, and/or animations described herein with reference to other methods described herein (e.g., methods **600**, **700**, **800**, **900**, **1000**, **1200**, and **1300**). For brevity, these details are not repeated here.

[0507] FIGS. **12**A-**12**D are flow diagrams illustrating method **1200** for placement of an insertion cursor, in accordance with some embodiments. Method **1200** is performed at a computer system (e.g., portable multifunction device **100**, FIG. **1**A, device **300**, FIG. **3**A, or a multi-component computer system including headset **5008** and input device **5010**, FIG. **5**A**2**) that includes (and/or is in communication with) a display generation component (e.g., a display, a projector, a heads-up display, or the like) and an input device (e.g., a touch-sensitive surface, such as a touch-sensitive remote control, or a touch-screen display that also serves as the display generation component, a mouse, a joystick, a wand controller, and/or cameras tracking the position of one or more features of the user such as the user's hands), optionally one or more cameras (e.g., video cameras that continuously provide a live preview of at least a portion of the contents that are within the field of view of the cameras and optionally generate video outputs including one or more streams of image frames capturing the contents within the field of view of the cameras), optionally one or more attitude sensors, optionally one or more sensors to detect intensities of contacts with the touch-sensitive surface, and optionally one or more tactile output generators. In some embodiments, the input device (e.g., with a touch-sensitive surface) and the display generation component are integrated into a touch-sensitive display. As described above with respect to FIGS. **3**B-**3**D, in some embodiments, method **1200** is performed at a computer system **301** (e.g., computer system **301**-*a*, **301**-*b*, or **301**-*c*) in which respective components, such as a display generation component, one or more cameras, one or more input devices, and optionally one or more attitude sensors are each either included in or in communication with computer system **301**.

[0508] In some embodiments, the display generation component is a touch-screen display and the input device (e.g., with a touch-sensitive surface) is on or integrated with the display generation component. In some embodiments, the display generation component is separate from the input device (e.g., as shown in FIG. **4**B and FIG. **5**A**2**). Some operations in method **1200** are, optionally, combined and/or the order of some operations is, optionally, changed.

[0509] For convenience of explanation, some of the embodiments will be discussed with reference to operations performed on a computer system with a touch-sensitive display system **112** (e.g., on device **100** with touch screen **112**) and one or more integrated cameras. However, analogous operations are, optionally, performed on a computer system (e.g., as shown in FIG. **5**A**2**) with a headset **5008** and a separate input device **5010** with a touch-sensitive surface in response to detecting the contacts on the touch-sensitive surface of the input device **5010** while displaying the user interfaces shown in the figures on the display of headset **5008**. Similarly, analogous operations are, optionally, performed on a computer system having one or more cameras that are implemented separately (e.g., in a headset) from one or more other components (e.g., an input device) of the computer system; and in some such embodiments, "movement of the computer system" corresponds to movement of one or more cameras of the computer system, or movement of one or more cameras in communication with the computer system.

[0510] As described below, method **1200** relates to input for placement of an insertion cursor (e.g., for indicating a location in a simulated environment for placement of an object). The same type of input can be used to insert the object in the simulated environment (e.g., when the input is received at a location that corresponds to a location of a displayed insertion cursor). Determining whether to display an insertion cursor at a location of a focus selector or to insert a first object at a location of a focus selector in response to detecting input of a first type, depending on whether the location of the focus selector corresponds a location of a displayed insertion cursor, enables the performance of multiple different types of operations with the first type of input. Enabling the performance of multiple different types of operations with the first type of input increases the efficiency with which the user is able to perform these operations, thereby enhancing the operability of the device, which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0511] The computer system (e.g., device **100**, FIG. **5E1**) displays (**1202**) via the display generation component of the first computer system, a simulated environment (e.g., a virtual reality environment or an augmented reality environment). For example, an augmented reality environment is displayed on display **112** of device **100**, as shown in FIG. **5E2**.

[0512] While displaying the simulated environment, the computer system detects (**1204**), via an input device (e.g., touch screen display **112** of device **100**), a first input that is directed to a respective location in the simulated environment. For example, in FIG. **5E7**, an input by a contact **5506** with touch screen display **112** is detected at a location that does not correspond to a location of an insertion cursor (e.g., insertion cursor **5504**). In FIG. **5E9**, an input by a contact **5510** with touch screen display **112** is detected at a location that corresponds to a location of an insertion cursor (e.g., insertion cursor **5508**).

[0513] In response to detecting the first input that is directed to the respective location in the simulated environment (**1206**), in accordance with a determination that the first input was of a first input type (e.g., a tap input detected at a location in the simulated environment) and that the first input was detected at a first location in the simulated environment other than a current location of an insertion cursor in the simulated environment (e.g., an input by a contact **5506** at a location that does not correspond to a current location of an insertion cursor **5504**, as shown in FIG. **5E7**), the computer system displays the insertion cursor at the first location (e.g., moving an existing insertion cursor from a prior location to the first location, or displaying a new insertion cursor at the first location if no insertion cursor was displayed in the simulated environment prior to the first input). For example, in response to the input by contact **5506** as shown in FIG. **5E7**, insertion cursor **5504** is moved from the location shown in FIG. **5E7** to the location where contact **5506** was received, as indicated by insertion cursor **5508** in FIG. **5E8**. In accordance with a determination that the first input was of the first input type and that the first input was detected at a second location in the simulated environment that corresponds to the current location of the insertion cursor (e.g., an input by a contact **5510** at a location that corresponds to a current location of an insertion cursor **5508**, as shown in FIG. **5E9**), the computer system inserts a first object (e.g., virtual box **5512**) at the second location and moves the insertion cursor to a third location that is on the first object (e.g., insertion cursor **5508** is moved to surface **5514** of virtual box **5512**).

[0514] In some embodiments, the device repeatedly performs (**1208**) the method **1200** over a plurality of successive iterations, wherein, in a first iteration of the successive iterations, the first input is of the first type and is detected at the first location in the simulated environment, and in response the insertion cursor is displayed at the first location; and, in a second iteration of the successive iterations, the first input is of the first type and is detected at the second location in the simulated environment that corresponds to the current location of the insertion points, and in response the first object is inserted at the second location and the insertion cursor is moved to the third location that is on the first object. Determining whether to display an insertion cursor at a location of a focus selector or to insert a first object at a location of a focus selector in response to detecting input of a first type, depending on whether the location of the focus selector corresponds a location of a displayed insertion cursor, enables the performance of multiple different types of operations with the first type of input. Enabling the performance of multiple different types of operations with the first type of input increases the efficiency with which the user is able to perform these operations, thereby enhancing the operability of the device, which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0515] In some embodiments, the first object has (**1210**) a plurality of non-adjacent sides, which are not adjacent to the second location (e.g., each respective non-adjacent side of the plurality of non-adjacent sides is not adjacent to the second location) that corresponds to the current location of the insertion cursor (e.g., the location of insertion cursor **5508** in FIG. **5E9**) and the third location on the first object is on a respective non-adjacent side of the plurality of non-adjacent sides that are not adjacent to the second location (e.g., the third location is side **5514** of virtual object **5512** (as shown in FIG. **5E10**), and side **5514** of virtual object **5512** is not adjacent to the position of insertion cursor **5508**). Moving the insertion cursor to a side of the first object that is not adjacent to the location where the first object was inserted improves the feedback provided to the user (e.g., by changing the location of the input cursor to make it visible to the user on a side of the first object), and reduces the number of inputs needed (e.g., to insert a new object at the third location). Reducing the number of inputs needed to insert a new object enhances the operability of the device, and makes the user-device interface more efficient which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0516] In some embodiments, in accordance with a determination that the current location of an insertion cursor is located on a respective side of a preexisting object (**1212**), the third location is on a first respective side of the first object that is parallel to the respective side of the preexisting object (e.g., if the cursor is on the top of the preexisting object, then the cursor is moved to a top of the first object, and if the cursor is on a front side of the preexisting object, then the cursor is moved to the front side of the first object). For example, in FIG. **5E11**, an input by contact **5516** is detected at a location that corresponds to insertion cursor **5508** while insertion cursor **5508** is located on top side **5514** of preexisting virtual box **5512**. In FIG. **5E12**, in response to the input by contact **5516**, new virtual box **5518** is displayed and insertion cursor **5508** is moved to the top side **5520** of new virtual box **5518**. Top side **5520** of new virtual box **5518**

is parallel to top side **5514** of preexisting virtual box **5512**. Moving the insertion cursor to a side of the first object that is parallel to a side of a preexisting object where the insertion cursor was located improves the feedback provided to the user (e.g., by placing the input cursor at a location that will enable continued expansion of the preexisting object along the same axis) and reduces the number of inputs needed (e.g., to insert a new object at the third location). Reducing the number of inputs needed to insert a new object enhances the operability of the device and makes the user-device interface more efficient which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0517] In some embodiments, (**1214**) the first location (that is not the current location of an insertion cursor) is on a first side of the preexisting object and the second location (that corresponds to the current location of the insertion cursor) is on a second side of the preexisting object that is different from the first side of the preexisting object. For example, while the insertion cursor **5508** is on a top side of the preexisting object (e.g., virtual box **5518** in FIG. **5**E**17**), a selection input (e.g., by contact **5524**) is detected on the front side **5528** of the preexisting object **5518**, in which case a displayed focus indicator such as an insertion cursor **5508** is moved to the front side **5528** of the preexisting object without adding a new object to the front side **5528** of the preexisting object **5518** (as shown in FIG. **5**E**18**). Alternatively, the selection input (e.g., by contact **5516**) is detected while an insertion cursor **5508** is on the top side of the preexisting object (e.g., top side **5514** of virtual box **5512** in FIG. **5**E**11**), in which case the first object (e.g., virtual box **5518**) is added to the top of the preexisting object (e.g., virtual box **5512**) and a displayed focus indicator such as an insertion cursor **5508** is moved to the top of the preexisting object that now includes the first object (e.g., as shown in FIG. **5**E**12**). Displaying an insertion cursor at a first side of a preexisting object (e.g., moving the insertion cursor from a current location to the first side of the preexisting object) or inserting a first object at a second side of the preexisting object (e.g., when input is received while a focus selector is at a location that corresponds to an insertion cursor that is at the second side of the preexisting object) enables the performance of multiple different types of operations with the first type of input. Enabling the performance of multiple different types of operations with the first type of input increases the efficiency with which the user is able to perform these operations, thereby enhancing the operability of the device, which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0518] In some embodiments, the simulated environment (e.g., as displayed by device **100** in FIG. **5**E3) is oriented (**1216**) relative to a physical environment **5200** of the computer system (e.g., the orientation of the simulated environment relative to the physical environment is independent of the orientation of the one or more attitude sensors of the computer system) and inserting the first object (e.g., virtual box **5512**) at the second location includes inserting the first object in the simulated environment (e.g., a rendered 3D model) at a location (and, optionally, in an orientation) in the simulated environment that is associated with a respective location (and, optionally, an orientation) of a respective physical reference object (e.g., physical reference mat **5208***a*) in the physical environment **5200** of the computer system (e.g., the first object is anchored to a physical reference object, such as a mat, and/or is associated with a virtual object that is anchored to the physical reference object). In some embodiments, the simulated environment includes images (e.g., in the background, such as beyond the first virtual user interface object) detected by one or more cameras (e.g., video cameras that continuously provides a live preview of at least a portion of the contents that are within the field of view of the cameras and optionally generates video outputs including one or more streams of images frames capturing the contents within the field of view of the cameras) of the computer system. In some embodiments, the simulated environment includes a simulated light source. In some embodiments, the simulated light source causes a shadow (e.g., **5522**, FIG. **5**E**10**) to be cast by the first object **5512** (and any other objects a displayed virtual model). In some embodiments, the shadow moves in response to a movement input detected by the input device that moves the first object and/or changes a viewing perspective of the first object (e.g., as shown in FIGS. **5**E**12**-**5**E**14**). Inserting a first object in a simulated environment at a location that is associated with a physical reference improves the feedback provided to the user (e.g., by making the computer system appear more responsive to user input), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by helping the user to achieve an intended outcome with the required inputs and reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0519] In some embodiments, in response to detecting the first input that is directed to the respective location in the simulated environment (**1218**), in accordance with a determination that the first input was of a second input type (e.g., the input includes an insertion command or selects a button or menu item that adds an object) and the insertion cursor is displayed at the second location in the simulated environment, the computer system inserts the first object at the second location in the simulated environment and moves the insertion cursor to the third location on the first object. For example, as shown in FIGS. **5**E**23**-**5**E**24**, an input by contact **5542** at a location that corresponds to new object control **5216** causes virtual box **5546** to be displayed at a location that corresponds to insertion cursor **5526**. The insertion cursor **5526** is moved to top side **5548** of virtual box **5546**. In some embodiments, in response to detecting the first input that is directed to the respective location in the simulated environment, in accordance with a determination that the first input was of the first input type (e.g., a tap input) and that the first input was detected at the second location in the simulated environment that corresponds to the current location of the insertion cursor, a first object is inserted at the second location. In accordance with a determination that the first input was of a third input type (e.g., the input includes selection of a respective surface of an object and movement of the input), the object is adjusted in accordance with the movement of the input (e.g., a size of the object is adjusted, based on the movement of the input, along an axis that is perpendicular to the selected side of the object and/or the object is moved in a direction based on the movement of the input). Inserting a first object in a simulated environment at a second location where an insertion cursor is displayed improves the feedback provided to the user (e.g., by making the computer system appear more responsive to user input), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by helping the user to achieve an intended outcome with the required inputs and reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0520] In some embodiments, the computer system detects (**1220**) a second input that includes selection of a second respective side of the first object and movement of the second input in two dimensions (e.g., movement of a contact across a planar touch-sensitive surface, or movement of a remote control that includes movement components in two orthogonal dimensions of the three-dimensional physical space around the remote control). For example, as indicated in FIGS. **5**E**25**-**5**E**26**, an input by contact **5550** selects side **5556** of virtual box **5546** and moves along a path indicated by arrow **5554**. In response to detecting the second input that includes movement of the second input in two dimensions (**1222**), in accordance with a determination that the second input meets movement criteria, (e.g., has a duration that is shorter than a long press duration and/or has a characteristic intensity of a contact with a touch-sensitive surface that does not increase above a resizing intensity threshold (e.g., a light press threshold IT_L, discussed above with regard to FIGS. **4**D-**4**E), the computer system moves the first object within a first plane that is parallel to the selected second respective side of the first object in a first direction determined based on the movement of the second input. For example, in FIGS. **5**E**25**-**5**E**26**, the second input meets movement criteria, and virtual box **5546** is moved within a plane indicated by movement projections **5552**. In accordance with a determination that the second input does not meet movement criteria, the computer system forgoes moving the first object. In some embodiments, the computer system detects a plurality of inputs that include selection of a second respective side of the first object and movement of the second input in two dimensions, wherein the plurality of inputs includes at least one input for which the second input meets movement criteria, and at least one input for which the second input does not meet movement criteria. In some embodiments, an amount of movement of the first object is dependent upon the magnitude of the movement of the second input. In some embodiments, a direction of movement of the first object is dependent upon the direction of the movement of the second input (e.g., as described in greater detail herein with reference to method **900**). Moving the object in response to input that includes movement in two dimensions improves the feedback provided to the user (e.g., by making the computer system appear more responsive to user input), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by helping the user to achieve an intended outcome with the required inputs and reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0521] In some embodiments, the computer system detects (**1224**) a third input that includes selection of a third respective side of the first object and movement of the third input in two dimensions. For example, in FIGS. **5**E**28**-**5**E**31**, an input by contact **5558** selects side **5556** of virtual box **5546** and moves along a path indicated by arrow **5562**. In response to detecting the third input that includes movement of the third input in two dimensions (**1226**), in accordance with a determination that the third input meets resize criteria, (e.g., has a duration that increases above a long press duration value and/or has a characteristic intensity of a contact with a touch-sensitive surface that increases above a resizing threshold (e.g., a light press threshold IT_L) the computer system adjusts, based on the movement of the third input, a size of the first object along an axis that is perpendicular to the selected third respective side of the first object (e.g., the axis is normal to the surface of the selected respective portion and is in contact with that surface). For example, in FIGS. **5**E**28**-**5**E**31**, the second input meets resize criteria, and a size of virtual box **5546** is increased along an axis indicated by resizing projections **5560**. In accordance with a determination that the third input does not meet resize criteria, the computer system forgoes adjusting the size of the first object. In some embodiments, the computer system detects a plurality of inputs that include selection of a third respective side of the first object and movement of the third input in two dimensions, wherein the plurality of inputs includes at least one input for which the third input meets resize criteria, and at least one input for which the second input does not meet resize criteria. In some embodiments, in response to detecting the third input that includes movement of the third input in two dimensions, in accordance with a determination that the third input meets resize criteria, a position of the first object is locked to an anchor point in the simulated environment. In some embodiments, an amount of adjustment of the size of the first object is dependent upon the magnitude of the movement of the third input. In some embodiments, a direction of adjustment of the size of the first object is dependent upon the direction of the movement of the third input (e.g., as described in greater detail herein with reference to method **900**). Adjusting a size of an object in response to input that meets resize criteria and includes movement in two dimensions improves the feedback provided to the user (e.g., by making the computer system appear more responsive to user input), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by helping the user to achieve an intended outcome with the required inputs and reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0522] In some embodiments, the computer system detects (**1228**) a fourth input that includes selection of a fourth respective side of the first object and movement of the fourth input in two dimensions. In response to detecting the fourth input that includes movement of the second input in two dimensions (**1230**), in accordance with a determination that the contact meets resizing criteria (e.g., has a duration that increases above a long press duration value and/or has a characteristic intensity of a contact with a touch-sensitive surface that increases above a resizing threshold (e.g., a light press threshold IT_L)) the computer system adjusts a size of the first object based on the movement of the fourth input. For example, in FIGS. **5**E**28**-**5**E**31**, an input by contact **5558** that selects side **5556** of virtual box **5546** and moves along a path indicated by arrow **5562** meets resize criteria, and a size of virtual box **5546** is increased along an axis indicated by resizing projections **5560**. In accordance with a determination that the contact does not meet resizing criteria, the computer system moves the first object based on the movement of the fourth input. For example, in FIGS. **5**E**25**-**5**E**26**, an input by contact **5550** that selects side **5556** of virtual box **5546** and moves along a path indicated by arrow **5554** meets movement criteria, and virtual box **5546** is moved within a plane indicated by movement projections **5552**. In some embodiments, the computer system detects a plurality of inputs that include selection of a fourth respective side of the first object and movement of the fourth input in two dimensions, wherein the plurality of inputs includes at least one input for which the contact meets movement criteria, and at least one input for which the contact does not meet movement criteria. Determining whether to adjust a size of an object or move the object in response to detecting an input by a contact on a touch sensitive surface, depending on whether, prior to movement of the contact across the touch sensitive surface, a characteristic intensity of the contact increased above an intensity threshold before a predefined delay time has elapsed, enables the performance of multiple different types of operations with the first type of input. Enabling the performance of multiple different types of operations with input by a contact on a touch sensitive surface increases the efficiency with which the user is able to perform these operations, thereby enhancing the operability of the device, which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0523] In some embodiments, adjusting the size of the first object based on the movement of the fourth input includes (**1232**) adjusting the size of the first object along an axis that is perpendicular to the selected third respective side of the first object. For example, in FIGS. **5**E**30**-**5**E**31**, a size of virtual box **5546** is adjusted along an axis, indicated by resizing projections **5560**, that is perpendicular to selected side **5556** of virtual box **5546**.

[0524] In some embodiments, moving the first object based on the movement of the fourth input includes (**1234**) moving the first object within a first plane that is parallel to the selected second respective side of the first object in a first direction determined based on the movement of the second input. For example, as indicated in FIGS. **5**E**25**-**5**E**26**, an input virtual box **5546** is moved in a plane, indicated by movement projections **5552**, that is parallel to selected side **5556** of virtual box **5546**.

[0525] In some embodiments, while the first object is displayed, the computer system detects (**1236**) a fifth input on a respective portion of the first object that does not correspond to the third location that is on the first object. For example, in FIGS. **5**E**11**-**5**E**12**, a first object is displayed in response to input (e.g., virtual box **5518** displayed in response to input by contact **5516**) and insertion cursor **5508** is moved to a third location (e.g., surface **5520** of virtual box **5518**). In FIG. **5**E**17**, an input by contact **5224** is detected at a location that does not correspond to the third location (e.g., contact **5224** is detected at surface **5528** of virtual box **5518**). In response to detecting the fifth input, the computer system moves (**1238**) the insertion cursor from the third location to a location that corresponds to the respective portion of the first object. For example in FIG. **5**E**18**, in response to the input by contact **5224**, the insertion cursor is moved from surface **5520** of virtual box **5518** to surface **5528** of virtual box **5518**). Moving an insertion cursor from a current location on an object to a different location on the object in response to an input improves the feedback provided to the user (e.g., by making the computer system appear more responsive to user input), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by helping the user to achieve an intended outcome with the required inputs and reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0526] It should be understood that the particular order in which the operations in FIGS. **12**A-**12**D have been described is merely an example and is not intended to indicate that the described order is the only order in which the operations could be performed. One of ordinary skill in the art would recognize various ways to reorder the operations described herein. Additionally, it should be noted that details of other processes described herein with respect to other methods described herein (e.g., methods **600**, **700**, **800**, **900**, **1000**, **1100**, and **1300**) are also applicable in an analogous manner to method **1100** described above with respect to FIGS. **12**A-**12**D. For example, the contacts, gestures, user interface objects, intensity thresholds, focus indicators, and/or animations described above with reference to method **1200** optionally have one or more of the characteristics of the contacts, gestures, user interface objects, intensity thresholds, focus indicators, and/or animations described herein with reference to other methods described herein (e.g., methods **600**, **700**, **800**, **900**, **1000**, **1100**, and **1300**). For brevity, these details are not repeated here.

[0527] FIGS. **13**A-**13**E are flow diagrams illustrating method **1300** for displaying an augmented reality environment in a stabilized mode of operation, in accordance with some embodiments. Method **1300** is performed at a computer system (e.g., portable multifunction device **100**, FIG. **1**A, device **300**, FIG. **3**A, or a multi-component computer system including headset **5008** and input device **5010**, FIG. **5**A**2**) that includes (and/or is in communication with) a display generation component (e.g., a display, a projector, a heads-up display, or the like) and an input device (e.g., a touch-sensitive surface, such as a touch-sensitive remote control, or a touch-screen display that also serves as the display generation component, a mouse, a joystick, a wand controller, and/or cameras tracking the position of one or more features of the user such as the user's hands), optionally one or more cameras (e.g., video cameras that continuously provide a live preview of at least a portion of the contents that are within the field of view of the cameras and optionally generate video outputs including one or more streams of image frames capturing the contents within the field of view of the cameras), optionally one or more attitude sensors, optionally one or more sensors to detect intensities of contacts with the touch-sensitive surface, and optionally one or more tactile output generators. In some embodiments, the input device (e.g., with a touch-sensitive surface) and the display generation component are integrated into a touch-sensitive display. As described above with respect to FIGS. **3**B-**3**D, in some embodiments, method **1300** is performed at a computer system **301** (e.g., computer system **301**-*a*, **301**-*b*, or **301**-*c*) in which respective components, such as a display generation component, one or more cameras, one or more input devices, and optionally one or more attitude sensors are each either included in or in communication with computer system **301**.

[0528] In some embodiments, the display generation component is a touch-screen display and the input device (e.g., with a touch-sensitive surface) is on or integrated with the display generation component. In some embodiments, the display generation component is separate from the input device (e.g., as shown in FIG. **4**B and FIG. **5**A**2**). Some operations in method **1300** are, optionally, combined and/or the order of some operations is, optionally, changed.

[0529] For convenience of explanation, some of the embodiments will be discussed with reference to operations performed on a computer system with a touch-sensitive display system **112** (e.g., on device **100** with touch screen **112**) and one or more integrated cameras. However, analogous operations are, optionally, performed on a computer system (e.g., as shown in FIG. **5**A**2**) with a headset **5008** and a separate input device **5010** with a touch-sensitive surface in response to detecting the contacts on the touch-sensitive surface of the input device **5010** while displaying the user interfaces shown in the figures on the display of headset **5008**. Similarly, analogous operations are, optionally, performed on a computer system having one or more cameras that are implemented separately (e.g., in a headset) from one or more other components (e.g., an input device) of the computer system; and in some such embodiments, "movement of the computer system" corresponds to movement of one or more cameras of the computer system, or movement of one or more cameras in communication with the computer system.

[0530] As described below, method **1300** relates to displaying an augmented reality environment that includes a virtual user interface object displayed concurrently with a field of view of one or more cameras. Depending on whether the augmented reality environment is displayed in a stabilized mode or a non-stabilized mode, updating the displayed augmented reality environment in response to detected movement (due to a change in attitude of at least a portion of a computer system relative to its physical environment) causes the displayed field of view of the one or more cameras to change by different amounts. Displaying the augmented reality environment in a stabilized mode or a non-stabilized mode enables the performance of multiple different types of operations (e.g., updating the displayed field of view by different amounts depending on whether the displayed view is locked to a portion of the field of view that is centered around the virtual user interface object) with the same detected movement. Enabling the performance of multiple different types of operations in response to the detected movement increases the efficiency with which the user is able to perform these operations, thereby enhancing the operability of the device, which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0531] The computer system (e.g., device **100**, FIG. **5**F**2**) displays (**1302**) via the display generation component **112** of the first computer system, an augmented reality environment. Displaying the augmented reality environment includes concurrently displaying a representation of at least a portion of a field of view of one or more cameras of the computer system and a virtual user interface object **5604**. The representation of the field of view of the one or more cameras includes a physical object **5602**. The representation of the field of view of the one or more cameras is updated as contents of the field of view of the one or more cameras change (e.g., the representation is a live preview of at least a portion of the field of view of the one or more cameras) The virtual user interface object **5604** is displayed at a respective location in the representation of the field of view of the one or more cameras, wherein the respective location of the virtual user interface object **5604** in the representation of the field of view of the one or more cameras is determined based on a fixed spatial relationship (e.g., size, orientation, and/or position) between the virtual user interface object **5604** and the physical object **5602** included in the representation of the field of view of the one or more cameras (e.g., a virtual user interface object that appears to be attached to, or cover, the physical object in the field of view of the one or more cameras).

[0532] While displaying the augmented reality environment, the computer system detects (**1304**), via one or more attitude sensors of the computer system, a first change in attitude (e.g., orientation and/or position) of at least a portion of the computer system (e.g., a change in attitude of a component of the computer system such as a component of the computer system that includes one or more cameras used to generate the representation of the physical environment) relative to a physical environment of the computer system. For example, FIGS. **5**F**3***a*-**5**F**4***a* illustrate movement of device **100** in a non-stabilized mode of operation and FIGS. **5**F**8***a*-**510***a*, **5**F**12***a*-**5**F**13***a*, and **5**F **16***a*-**5**F **17***a* illustrate movement of device **100** in a stabilized mode of operation.

[0533] In response to detecting the first change in attitude of the portion of the computer system relative to the physical environment of the computer system, the computer system updates (**1306**) the augmented reality environment in accordance with the first change in attitude of the portion of the computer system. In accordance with a determination that the augmented reality environment is displayed in a non-stabilized mode of operation, updating the augmented reality environment in accordance with the first change in attitude of the portion of the computer system includes updating the representation of the portion of the field of view of the one or more cameras by a first amount of adjustment that is based on the first change in attitude of the portion of the computer system relative to the physical environment of the computer system (e.g., as shown in FIGS. **5**F**3***b*-**5**F**4***b*) and updating the respective location of the virtual user interface object **5604** to a location that is selected so as to maintain the fixed spatial relationship (e.g., size, orientation, and/or position) between the virtual user interface object **5604** and the physical object **5602** included in the representation of the field of view of the one or more cameras. In accordance with a determination that the augmented reality environment is displayed in a stabilized mode of operation, updating the augmented reality environment in accordance with the first change in attitude of the portion of the computer system includes: updating the representation of the portion of the field of view of the one or more cameras by a second amount of adjustment that is based on the first change in attitude of the portion of the computer system relative to the physical environment of the computer system and that is less than the first amount of adjustment (e.g., the displayed view is locked to the sub-portion of the field of view that is centered around the first virtual user interface object) and updating the respective location of the virtual user interface object **5604**

to a location that is selected so as to maintain the fixed spatial relationship (e.g., size, orientation, and/or position) between the virtual user interface object **5604** and the physical object **5602** included in the representation of the field of view of the one or more cameras. For example, in FIGS. **5**F **16***b*-**5**F **17***b* the representation of the portion of the field of view of the one or more cameras is updated by an amount that is less than the amount of adjustment that is less than the amount of adjustment that occurs in FIGS. **5**F**3***b*-**5**F**4***b*. In some embodiments, the computer system repeatedly performs the method **1300** over a plurality of successive iterations, wherein, in a first iteration of the successive iterations, the augmented reality environment is displayed in a non-stabilized mode of operation, and, in a second iteration of the successive iterations, the augmented reality environment is displayed in a stabilized mode of operation.

[0534] In some embodiments, when the augmented reality environment was displayed in the non-stabilized mode of operation when the first change in attitude of the portion of the computer system (e.g., a change in attitude of a component of the computer system such as a component of the computer system that includes one or more cameras used to generate the representation of the physical environment) was detected (**1308**), after updating the augmented reality environment in accordance with the first change in attitude of the portion of the computer system, the computer system receives (**1308**-*a*) a request to stabilize the virtual user interface object on the display (e.g., an input at a stabilization control **5616**). In response to the request to stabilize the virtual user interface object on the display, the computer system enters (**1308**-*b*) a stabilized mode of operation for the augmented reality environment. While in the stabilized mode of operation for the augmented reality environment, the computer system (**1308**-*c*) detects, via the one or more orientation sensors, a second change in attitude (e.g., orientation and/or position) of the portion of the computer system relative to the physical environment (e.g., as illustrated at FIGS. **5**F**16***a*-**5**F**17***a*) and, in response to detecting the second change in attitude of the portion of the computer system (e.g., a change in attitude of a component of the computer system such as a component of the computer system that includes one or more cameras used to generate the representation of the physical environment) relative to the physical environment, the computer system updates the augmented reality environment in accordance with the second change in attitude of the portion of the computer system, including: updating the representation of the portion of the field of view of the one or more cameras by less than an amount of the second change in attitude of the portion of the computer system (or a component of the computer system such as a component of the computer system that includes one or more cameras used to generate the representation of the physical environment) relative to the physical environment and updating the virtual user interface object **5604** to a location selected so as to maintain the fixed spatial relationship (e.g., size, orientation, and/or position) between the virtual user interface object **5604** and the representation of the physical object **5602** included in the field of view of the one or more cameras. For example, in FIGS. **5**F **16***b*-**5**F**17***b* the representation of the portion of the field of view of the one or more cameras is updated by an amount that is less than the amount of adjustment that is less than the amount of adjustment that occurs in FIGS. **5**F**3***b*-**5**F**4***b*. Entering a stabilized mode of operation for the augmented reality environment in response to a request to stabilize the virtual user interface object on the display improves the displayed augmented reality environment (e.g., by allowing the user to view the virtual user interface object regardless of data available from the one or more cameras), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by helping the user to achieve an intended outcome with the required inputs and reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0535] In some embodiments, the computer system includes an input device and the request to stabilize the virtual user interface object on the display includes (**1310**) an input, received via the input device, for zooming at least a portion of the augmented reality environment (e.g., a depinch-to-zoom input by contacts **5606** and **5608** as illustrated at FIG. **5**F**6***b*-**5**F**7***b*). In some embodiments, input for zooming is, e.g., a pinch, double tap, or selection/manipulation of a zoom affordance. In some embodiments, in response to receiving the input for zooming at least a portion of the augmented reality environment, the device zooms the augmented reality environment (e.g. as shown in FIGS. **5**F**6***b*-**5**F**7***b*, the size of virtual user interface object **5604** in the augmented reality environment is increased in response to the depinch-to-zoom input). In some embodiments, the zooming is a predetermined amount of zooming or zooming to a predetermined zoom level. In some embodiments, a magnitude of the zooming is based on a magnitude of the input (e.g., an amount of movement of two contacts apart from each other or an amount of movement of a contact on a zoom control). Entering a stabilized mode of operation for the augmented reality environment in response to a zoom input enables the stabilization mode without requiring further user input. Entering a stabilization mode without requiring further user input enhances the operability of the device, and makes the user-device interface more efficient, which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0536] In some embodiments, in response to the request to stabilize the virtual user interface object on the display, wherein the request to stabilize the virtual user interface object on the display includes the input for zooming the portion of the displayed augmented reality environment, the computer system re-renders (**1312**) the virtual user interface object (e.g., from a lower resolution to a higher resolution) in accordance with the magnitude of the input for zooming the portion of the displayed augmented reality environment (e.g., without re-rendering the representation of the portion of the field of view of the one or more cameras.) For example, in FIG. **5**F**7***b*, virtual object **5604** is re-rendered in response to the depinch-to-zoom input received in **5**F**6***b*-**5**F**7***b*. In some embodiments, in response to the request to stabilize the virtual user interface object on the display, wherein the request to stabilize the virtual user interface object on the display includes the input for zooming the displayed augmented reality environment, the field of view of the one or more cameras remains the same. In some embodiments, camera zoom of the one or more cameras is activated and the field of view of the one or more cameras is zoomed while the virtual user interface object is zoomed. Re-rendering the virtual user interface object in accordance with the magnitude of the zoom input improves the feedback provided to the user (e.g., by making the computer system appear more responsive to user input), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by helping the user to achieve an intended outcome with the required inputs and reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0537] In some embodiments, the physical object **5602** is replaced by (**1314**) the virtual user interface object **5604** in the displayed augmented reality environment (e.g., the displayed view is locked to the sub-portion of the field of view that is centered around the first virtual user interface object). Replacing the physical object with a virtual user interface object in the displayed augmented reality environment increases the range of options for providing visual information to the user about the physical object (e.g., by providing additional or enhanced visual information in the virtual user interface object not available from the physical object) and makes the user-device interface more efficient (e.g., by providing additional information in connection with the physical object without needing to separately display the additional information and a camera view of the physical object) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0538] In some embodiments, the computer system detects (**1316**) a first respective change in attitude of the portion of the computer system relative to the physical environment of the computer system while the augmented reality environment is displayed in the stabilized mode of operation (e.g., device **100** is moved as illustrated at FIG. **5**F**8***a*-**5**F **10***a*). In response to detecting the first respective change in attitude of the portion of the computer system relative to the physical environment of the computer system while the augmented reality environment is displayed in the stabilized mode of operation, the computer system updates (**1318**) the augmented reality environment in accordance with the respective change in attitude of the portion of the computer system, including, in accordance with a determination that the updated respective location of the virtual user interface object **5604** extends beyond the field of view of the one or more cameras, (continuing to display the virtual user interface object locked to the sub-portion of the field of view that is centered around the virtual user interface object, and) updating the representation of the portion of the field of view of the one or more cameras includes displaying a placeholder image **5614** (e.g., a blank space or a rendered image) at a respective location in the augmented reality environment that corresponds to the portion of the virtual user interface object that extends beyond the field of view of the one or more cameras (e.g., to fill in the background beyond the virtual user interface object where the live camera image is no longer available). For example, when virtual user interface object **5604** would extend beyond the field of view of the one or more cameras, the augmented reality environment including virtual user interface object **5604** is zoomed out such that virtual user interface object **5604** is fully displayed. When the augmented reality environment is zoomed out, a live camera image is no longer available for a portion of the background beyond the virtual user interface object. In some embodiments, updating the augmented reality environment in accordance with the first respective change in attitude of the portion of the computer system in response to detecting the first respective change in attitude of the portion of the computer system relative to the physical environment of the computer system includes determining whether the updated respective location of the virtual user interface object **5604** extends beyond the field of view of the one or more cameras. Displaying a placeholder image in the augmented reality environment at a location that corresponds to a portion of the virtual user interface object that extends beyond a camera view improves the feedback provided to the user (e.g., by providing a visual cue to the user to help the user understand that the portion of the virtual user interface object extends beyond the camera view), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by helping the user to achieve an intended outcome with the required inputs and reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0539] In some embodiments, the computer system detects (**1320**) a second respective change in attitude of the portion of the computer system relative to the physical environment of the computer system while the augmented reality environment is displayed in the stabilized mode of operation (e.g., device **100** is moved as illustrated at FIGS. **5**F**8***a*-**5**F**9***a* or as illustrated at FIGS. **5**F **16***a*-**5**F **17***a*). In response to detecting the second respective change in attitude of the portion of the computer system relative to the physical environment of the computer system while the augmented reality environment is displayed in the stabilized mode of operation, the computer system updates (**1322**) the augmented reality environment in accordance with the respective change in attitude of the portion of the computer system, including, in accordance with a determination that the updated respective location of the virtual user interface object **5604** extends beyond the field of view of the one or more cameras, ceasing to display at least a portion of the virtual user interface object **5604** (e.g., while continuing to display the virtual user interface object **5604** locked to the sub-portion of the field of view that is centered around the virtual user interface object). For example, in FIG. **5**F**9***b* and in FIG. **5**F**17***b*, the virtual user interface object **5604** extends beyond the field of view of the one or more cameras and a portion of the virtual user interface object **5604** is not displayed. In some embodiments, updating the augmented reality environment in accordance with the second respective change in attitude of the portion of the computer system in response to detecting the second respective change in attitude of the portion of the computer system relative to the physical environment of the computer system includes determining whether the updated respective location of the virtual user interface object extends beyond the field of view of the one or more cameras. In some embodiments, in accordance with a determination that the respective change in attitude of the portion of the computer system relative to the physical environment would cause the virtual user interface object to move to a location that is beyond the field of view of the one or more cameras, a constrained stabilization mode is activated in which the virtual user interface object is constrained to a location that corresponds to the field of view of the one or more cameras. In some embodiments, a third change in attitude of at least a portion of the computer system relative to the physical environment is detected while the virtual user interface object is constrained to the location that corresponds to the field of view of the one or more cameras. In response to the third change in attitude of the portion of the computer system relative to the physical environment, in accordance with a determination that the third change in attitude of the portion of the computer system relative to the physical environment would cause the virtual user interface object to move to a location that is not beyond the field of view of the one or more cameras, the constrained stabilization mode ends. Ceasing to display at least a portion of the virtual user interface object portion of the virtual user interface object (e.g., a portion of the virtual user interface object that extends beyond a camera view) improves the feedback provided to the user (e.g., by providing a visual cue to the user to help the user understand that the portion of the virtual user interface object extends beyond the camera view), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by helping the user to achieve an intended outcome with the required inputs and reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0540] In some embodiments, in response to detecting the respective change in attitude of the portion of the computer system relative to the physical environment of the computer system while the augmented reality environment is displayed in the stabilized mode of operation (e.g., detecting movement of device **100** as illustrated at FIGS. **5**F**8***a*-**5**F**9***a*), updating the augmented reality environment in accordance with the respective change in attitude of the portion of the computer system includes (**1324**), in accordance with a determination that the updated respective location of the virtual user interface object **5604** extends beyond the field of view of the one or more cameras, zooming the displayed augmented reality environment to increase a portion of the displayed virtual user interface object (e.g., as illustrated at FIGS. **5**F**9***b*-**5**F **10***b*), and in accordance with a determination that the updated respective location of the virtual user interface object does not extend beyond the field of view of the one or more cameras, moving the virtual user interface object without zooming the displayed augmented reality environment. In some embodiments, the computer system detects a plurality of changes in attitude of the portion of the computer system relative to the physical environment of the computer system while the augmented reality environment is displayed in the stabilized mode of operation, wherein the plurality of changes in attitude includes at least one change in attitude in response to which the updated respective location of the virtual user interface object extends beyond the field of view of the one or more cameras, and at least one change in attitude in response to which the updated respective location of the virtual user interface object does not extend beyond the field of view of the one or more cameras. Zooming the displayed augmented reality environment to increase a portion of the displayed virtual user interface object in the stabilized mode when movement of the computer system would cause the virtual user interface object to extend beyond the camera view improves the feedback provided to the user (e.g., by allowing the user to continue to view the full virtual user interface object regardless of movement of the device), enhances the operability of the device, and makes the user-device interface more efficient (e.g., by helping the user to achieve an intended outcome with the required inputs and reducing user mistakes when operating/interacting with the device) which, additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

[0541] It should be understood that the particular order in which the operations in FIGS. **13**A-**13**E have been described is merely an example and is not intended to indicate that the described order is the only order in which the operations could be performed. One of ordinary skill in the art would recognize various ways to reorder the operations described herein. Additionally, it should be noted that details of other processes described herein with respect to other methods described herein (e.g., methods **600**, **700**, **800**, **900**, **1000**, **1100**, and **1200**) are also applicable in an analogous manner to method **1100** described above with respect to FIGS. **13**A-**13**E. For example, the contacts, gestures, user interface objects, focus indicators, and/or animations described above with reference to method **1300** optionally have one or more of the characteristics of the contacts, gestures, user interface objects, intensity thresholds, focus indicators, and/or animations described herein with reference to other methods described herein (e.g., methods **600**, **700**, **800**, **900**, **1000**, **1100**, and **1200**). For brevity, these details are not repeated here.

[0542] The operations described above with reference to FIGS. **6**A-**6**D, **7**A-**7**C, **8**A-**8**C, **9**A-**9**E, **10**A-**10**E, **11**A-**11**C, **12**A-**12**D, and **13**A-**13**E are, optionally, implemented by components depicted in FIGS. **1**A-**1**B. For example, display operations **602**, **702**, **802**, **808**, **902**, **1002**, **1014**, **1102**, **1202**, **1206**, and **1302**; detection operations **606**, **706**, **806**, **904**, **1004**, **1008**, **1012**, **1106**, **1204**, and **1304**; detection and adjusting operations **608**, adjusting and applying operations **708**; adjusting operations **906**; changing operation **1006**; performing operation **1010**; transitioning operation **1014**; updating operations **1108** and **1306**; and display and inserting operation **1206**; are, optionally, implemented by event sorter **170**, event recognizer **180**, and event handler **190**. Event monitor **171** in event sorter **170** detects a contact on touch-sensitive display **112**, and event dispatcher module **174** delivers the event information to application **136-1**. A respective event recognizer **180** of application **136-1** compares the event information to respective event definitions **186**, and determines whether a first contact at a first location on the touch-sensitive surface (or whether rotation of the device) corresponds to a predefined event or sub-event, such as selection of an object on a user interface, or rotation of the device from one orientation to another. When a respective predefined event or sub-event is detected, event recognizer **180** activates an event handler **190** associated with the detection of the event or sub-event. Event handler **190** optionally uses or calls data updater **176** or object updater **177** to update the application internal state **192**. In some embodiments, event handler **190** accesses a respective GUI updater **178** to update what is displayed by the application. Similarly, it would be clear to a person having ordinary skill in the art how other processes can be implemented based on the components depicted in FIGS. **1**A-**1**B.

[0543] The foregoing description, for purpose of explanation, has been described with reference to specific embodiments. However, the illustrative discussions above are not intended to be exhaustive or to limit the invention to the precise forms disclosed. Many modifications and variations are possible in view of the above teachings. The embodiments were chosen and described in order to best explain the principles of the invention and its practical applications, to thereby enable others skilled in the art to best use the invention and various described embodiments with various modifications as are suited to the particular use contemplated.

What is claimed is:

1. A method, comprising:

at a computer system having a display generation component, one or more cameras, and an input device:

displaying, via the display generation component, an augmented reality environment, wherein displaying the augmented reality environment includes concurrently displaying:

a representation of at least a portion of a field of view of the one or more cameras that includes a respective physical object, wherein the representation is updated as contents of the field of view of the one or more cameras change; and

a respective virtual user interface object at a respective location in the representation of the field of view of the one or more cameras, wherein the respective virtual user interface object has a location that is determined based on the respective physical object in the field of view of the one or more cameras;

while displaying the augmented reality environment, detecting an input at a location that corresponds to the respective virtual user interface object; and

while continuing to detect the input:

detecting movement of the input relative to the respective physical object in the field of view of the one or more cameras; and

in response to detecting the movement of the input relative to the respective physical object in the field of view of the one or more cameras, adjusting an appearance of the respective virtual user interface object in accordance with a magnitude of movement of the input relative to the respective physical object.

2. The method of claim **1**, wherein adjusting the appearance of the respective virtual user interface object in accordance with the magnitude of movement of the input relative to the respective physical object includes:

in accordance with a determination that the magnitude of movement of the input relative to the respective physical object is a first magnitude, adjusting the appearance of the respective virtual user interface object by a first adjustment; and

in accordance with a determination that the magnitude of movement of the input relative to the respective physical object is a second magnitude distinct from the first magnitude, adjusting the appearance of the respective virtual user interface object by a second adjustment distinct from the first adjustment.

3. The method of claim **1**, wherein the respective virtual user interface object is anchored, before and after the adjusting, to the respective physical object in the field of view of the one or more cameras.

4. The method of claim **1**, wherein the appearance of the respective virtual user interface object is adjusted in response to detecting the movement of the input relative to the respective physical object in the field of view of the one or more cameras without regard to whether the movement of the input is due to:

movement of the input on the input device,

movement of the one or more cameras relative to the respective physical object, or

a combination of the movement of the input on the input device and the movement of the one or more cameras relative to the respective physical object.

5. The method of claim **1**, wherein the movement of the input relative to the respective physical object is based on:

movement of the field of view of the one or more cameras relative to the respective physical object; and

movement of the input on the input device.

6. The method of claim **1**, wherein the movement of the input relative to the respective physical object is based on movement of the input on the input device, and the method includes:

after adjusting the appearance of the respective virtual user interface object in accordance with the magnitude of movement of the input relative to the respective physical object:

detecting movement of the field of view of the one or more cameras relative to the respective physical object; and

in response to detecting the movement of the field of view of the one or more cameras relative to the respective physical object, continuing to adjust the appearance of the respective virtual user interface object in accordance with a magnitude of movement of the field of view of the one or more cameras relative to the respective physical object.

7. The method of claim **1**, wherein the movement of the input relative to the respective physical object is based on movement of the field of view of the one or more cameras relative to the respective physical object, and the method includes:

after adjusting the appearance of the respective virtual user interface object in accordance with the magnitude of movement of the input relative to the respective physical object:

detecting movement of the input on the input device; and

in response to detecting the movement of the input on the input device, continuing to adjust the appearance of the respective virtual user interface object in accordance with a magnitude of movement of the input on the input device.

8. The method of claim **1**, wherein:

detecting the input at the location that corresponds to the respective virtual user interface object includes detecting the input at a first contact point on the respective virtual user interface object; and

the computer system updates the display of the respective virtual user interface object so as to maintain display of the first contact point on the respective virtual user interface object at a location that corresponds to a location of the input.

9. The method of claim **1**, wherein:

movement of the input relative to the respective physical object includes movement of the computer system; and

a determination of movement of the computer system is derived from image analysis that indicates one or more reference points within the field of view of the one or more cameras have changed between successive images captured by the one or more cameras.

10. The method of claim **1**, wherein adjusting the appearance of the respective virtual user interface object includes moving at least a portion of the respective virtual user interface object, wherein movement of the respective virtual user interface object is based on a physical shape of the respective physical object.

11. The method of claim **1**, wherein adjusting the appearance of the respective virtual user interface object includes moving at least a portion of the respective virtual user interface object, wherein movement of the respective virtual user interface object is based on concurrent movement of one or more touch inputs and movement of the computer system.

12. The method of claim **1**, wherein adjusting the appearance of the respective virtual user interface object includes moving at least a portion of the respective virtual user interface object beyond a maximum limit of a resting state of the respective virtual user interface object, and the method includes:

while continuing to detect the input, displaying the respective virtual user interface object at a location beyond the maximum limit of the resting state of the respective virtual user interface object, in accordance with the magnitude of movement of the input relative to the respective physical object;

ceasing to detect the input; and

in response to ceasing to detect the input, displaying the respective virtual user interface object at a location corresponding to the maximum limit of the resting state of the respective virtual user interface object.

13. The method of claim **1**, wherein the displayed augmented reality environment includes:

one or more virtual objects that do not correspond to physical objects in the field of view of the one or more cameras;

one or more physical objects that are in the field of view of the one or more cameras; and

one or more 3D virtual models of the one or more physical objects that are in the field of view of the one or more cameras that replace at least a portion of the corresponding one or more physical objects.

14. The method of claim **1**, wherein the respective physical object is a 3D marker that is recognizable from different angles and the respective virtual user interface object is a 3D virtual model that is overlaid on the respective physical object based on a camera angle of the one or more cameras.

15. A computer system, comprising:

a display generation component;

one or more cameras;

an input device;

one or more processors; and

memory storing one or more programs, wherein the one or more programs are configured to be executed by the one or more processors, the one or more programs including instructions for:

displaying, via the display generation component, an augmented reality environment, wherein displaying the augmented reality environment includes concurrently displaying:

a representation of at least a portion of a field of view of the one or more cameras that includes a respective physical object, wherein the representation is updated as contents of the field of view of the one or more cameras change; and

a respective virtual user interface object at a respective location in the representation of the field of view of the one or more cameras, wherein the respective virtual user interface object has a location that is determined based on the respective physical object in the field of view of the one or more cameras;

while displaying the augmented reality environment, detecting an input at a location that corresponds to the respective virtual user interface object; and

while continuing to detect the input:

detecting movement of the input relative to the respective physical object in the field of view of the one or more cameras; and

in response to detecting the movement of the input relative to the respective physical object in the field of view of the one or more cameras, adjusting an appearance of the respective virtual user interface object in accordance with a magnitude of movement of the input relative to the respective physical object.

16. A computer readable storage medium storing one or more programs, the one or more programs comprising instructions, which, when executed by a computer system with a display generation component, one or more cameras, and an input device, cause the computer system to:

display, via the display generation component, an augmented reality environment, wherein displaying the augmented reality environment includes concurrently displaying:

a representation of at least a portion of a field of view of the one or more cameras that includes a respective physical object, wherein the representation is updated as contents of the field of view of the one or more cameras change; and

a respective virtual user interface object at a respective location in the representation of the field of view of the one or more cameras, wherein the respective virtual user interface object has a location that is determined based on the respective physical object in the field of view of the one or more cameras;

while displaying the augmented reality environment, detect an input at a location that corresponds to the respective virtual user interface object; and

while continuing to detect the input:

detect movement of the input relative to the respective physical object in the field of view of the one or more cameras; and

in response to detecting the movement of the input relative to the respective physical object in the field of view of the one or more cameras, adjust an appearance of the respective virtual user interface object in accordance with a magnitude of movement of the input relative to the respective physical object.

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